The Dissertation Committee for Jiyoung Kim Certifies that this is the approved version of the following dissertation:

The Effect of Situated Learning on Knowledge Transfer of Students with and without Disabilities in Inclusive Classrooms: A Meta-Analysis

Committee:

Herbert J. Rieth, Supervisor

Diane P. Bryant

Audrey M. Sorrells

Phyllis M. Robertson

Susan N. Beretvas

The Effect of Situated Learning on Knowledge Transfer of Students with and without Disabilities in Inclusive Classrooms: A Meta-Analysis

by

Jiyoung Kim, B.A.; M.A.

Dissertation

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas at Austin

May 2012

Dedication

I dedicate this dissertation to my father in heaven.

Acknowledgements

My time as a doctoral student in the United States was very special for me not only because I equipped myself to be an expert in the field of special education, but also because I learned much about myself, life, and others around me. Just as a diamond is made under great pressure during a period of many years, the hardships I have come through during my doctoral years have taught me to pursue only one goal—how to truly be a professional who can empower people with disabilities and their families— and only one person, Jesus, in every circumstance. Now, almost at the finish line, I am grateful to say I have come to learn how to walk with God in great joy, with people who share the same heart that I have.

There are many special individuals with whom I want to share my joy and gratitude. First of all, I would like to give special thanks to my advisor, Dr. Herbert Rieth, for all his support and professional guidance throughout my doctoral years at the University of Texas at Austin. Without his encouragement and help, I could not have completed this long and challenging journey. I also want to express my appreciation to my dissertation committee members, Dr. Diane Bryant, Dr. Phyllis Robertson, Dr. Audrey Sorrells, and Dr. Susan Beretvas, for their insightful comments and valuable suggestions in this dissertation process. I admire the deep passion of all the faculty members towards their students' learning.

To Dr. William Myers and Dr. Cathy Thomas, I would like to give my sincere thanks. While I was working with them as a TA, I learned so much from their excellent teachings and skillful ways of class management. Dr. Myers, you always remind me of my father, who went to heaven during my doctoral years. You always trust everything I do and encourage me so I can challenge myself to rise above my own standards, just as my father did!

I also want to give thanks to my two professors, Dr. Seunghee Park at Ewha University and Dr. Ilju Rha, at Seoul National University. They are the professors who started me off on this academic journey and kept encouraging me to pursue my dreams. To my Korean friends in Austin; I will always remember the time we spent sharing our concerns and praying for each other. Just knowing that you all were with me was enough to keep me going.

Finally, I want to give my deepest love and special gratitude to my family. My parents and parents-in-law have always been by my side to support me in all that I do. To my father; I know you have always been with me throughout my doctoral years and how much you delight in me now. I deeply want to bring you greatest pride and joy when we meet again someday in heaven. To my mother; I give you my heartfelt thanks for your endless love and unconditional trust. Without your encouragement and support, I would not be able to complete this race. Thank you for everything that you have ever done for me. Taeyeon, my talented brother; whenever I was discouraged, your kind words, humor and brilliant advice cheered me up. You are my amazing, one-and-only brother!

To my lovely son and daughter, Jongnam and Zion; I love you so much. It is truly the greatest joy for me to see my little boy and girl grow into such beautiful people. You are the most precious gifts and blessings God gave me! I sincerely want to express my great love and thanks to my husband, Sunghun. I really appreciate all the support and everlasting love you have shown me while walking this long and challenging journey together. You are the best husband, colleague, and faithful friend to me.

The Effect of Situated Learning on Knowledge Transfer of Students with and without Disabilities in Inclusive Classrooms: A Meta-Analysis

Jiyoung Kim, Ph.D.

The University of Texas at Austin, 2012

Supervisor: Herbert J. Rieth

The purpose of this meta-analysis was to examine the effect of situated learning on the academic performance of students with and without disabilities in inclusive general education classrooms. While previous research has reported the overall effectiveness of situated learning, relatively few studies have been conducted to investigate how situated learning influences students' academic performances in inclusive settings where students with and without disabilities work together. Moreover, although the main interest of situated learning is about how to apply basic knowledge and skills to an authentic context and, beyond this, how to transfer them into a similar but novel situation in everyday life, little has been known about its effectiveness on students' achievement in terms of knowledge transfer.

In this study, a meta-analytical statistical method was employed to investigate the effect of situated learning, and its effectiveness was examined according to the three levels of knowledge transfer (knowledge acquisition, application, and transfer). A total of 19 situated-learning studies, both published and unpublished, were analyzed. Each

primary study's effect sizes were calculated using Hedges' *g* with the bias correction and then combined into the three weighted average effect sizes regarding the levels of knowledge transfer.

This meta-analytic study found that, on all of the levels of knowledge transfer, the situated learning is effective for the learning of students with and without disabilities in inclusive general education classrooms. In the random effects model, the situated instruction produced a weighted mean effect size estimate of 2.049 for knowledge acquisition, 1.836 for knowledge application, 1.185 for knowledge transfer. In addition, the percentage of students with special needs in general education classrooms had a negative influence on the effectiveness of situated learning. However, the pattern of results also showed that the proportion of students with special needs in general education classrooms does not influence as greatly the learning of knowledge transfer as it does knowledge acquisition or application.

Table of Contents

List of Tables

CHAPTER 1: INTRDUCTION

Statement of the Problem

Current education reform policies (i.e., Individuals with Disabilities Education Improvement Act of 2004 [IDEA], 2004; No Child Left Behind of Act 2001[NCLB], 2002) impose rigorous achievement standards for both students with and without disabilities (Gersten, Baker, Smith-Johnson, Dimino, & Peterson, 2006; Miller & Hudson, 2007; Neil, Guisbond, Schaeffer, Madden, & Legeros, 2004; Turnbull, 2009; Woodward, 2004). Concerns about students' learning outcomes have grown enormously in recent years. As part of the effort to meet accountability standards in education, students are asked to demonstrate adequate yearly academic progress (AYP) and to achieve at least a proficient level score on each standard (NCLB, 2001).

Educational standards go beyond literacy skills and retention of knowledge, to examine the extent that students can apply knowledge and skills to solve complex problems embedded in diverse contexts (Bottge, Rueda, LaRoque, Serlin, & Kwon, 2007; Gersten et al., 2006; Hasselbring & Moore, 1996; Woodward, 2004). In mathematics, for example, the National Council of Teachers of Mathematics [NCTM] (2000) provided five "process standards" that students must be taught in a K-12 school system. These include (a) problem solving, (b) reasoning and proof, (c) communication, (d) connections, and (e) representations. This means that in learning of five mathematics content areas (i.e., numbers and operation, algebra, geometry, measurement, and data analysis and probability), students must become proficient not only with computational skills but also "conceptual understanding" in order to combine relevant knowledge and skills with given problems in authentic application contexts (Woodward, 2004).

Unfortunately, according to the National Assessment of Education Progress (NAEP), 41% of fourth-grade students without disabilities performed at or above proficient level in mathematics, and only 19% of students with disabilities performed at or above proficient level (NAEP, 2009). In U.S. history, 30% of eighth-grade students without disabilities performed below the basic level, whereas about 66% of students with disabilities in the grades performed below the basic level (NAEP, 2006).

In a historical review of mathematics education in the United States from the late 1950s to date, Woodward (2004) indicated that contemporary instructional approaches promoted by education reform were too challenging for students with disabilities and often beyond the students′ capacity for cognitive work:

> Conceptual understanding is a significant part of mathematics reform that is only rarely described in the special education literature... students with LD (i.e., learning disabilities) face in learning complex concepts and problems... (they) tend to exhibit difficulties with the cognitive load of the activities and curricular materials. Unless there is additional support in the class to mediate the instruction, these students tend to assume passive roles, and their progress is substantially slower than that of their peers without LD. (p. 25)

Even when students with disabilities possess the prerequisite knowledge, they are often unable to activate it to apply to an authentic situation; they don′t know how or when to apply the knowledge (Goldman et al., 1997; Hasselbring & Moore, 1996). According to Hasselbring and Moore (1996),

> the difficulty of teaching students how to solve problems can be attributed in part to students′ inability to perceive instances in which knowledge they already possess is useful. The ability to literally ″notice″ and retrieve useful information appears to be especially problematic for children with learning problems or those who are at-risk of school failure and these skills are not developed in traditional word-problem formats (p. 209).

This suggests that problems to be solved should be couched in a meaningful context so that students with and without disabilities can have shared background. Teachers must provide their students opportunities to practice problem solving within contextualized situations. This way students will be able to more easily understand how, where, and when to transfer their knowledge to an authentic situation (Bottge & Hasselbring, 1993; Gersten et al., 2006; Young, 1993).

In sum, although current educational reform requires conceptual understanding to solve complex problems embedded in diverse contexts, students have difficulties applying relevant knowledge and skills to an authentic context given in problems. Especially for students with disabilities included in a reform-based general education classroom, such higher order learning is more challenging.

Previous research indicated that the dominant difficulties students with disabilities experience can be attributed in part to 'de-contextualized learning,' mainly driven by textbooks having too much information in the allotted pages without conceptual coherence (Bean, Zigmond, & Hartman, 1994; De La Paz & MacArthur, 2003; Ferretti, MacArthur, & Okolo, 2001; Scruggs & Mastropieri, 2003). Although students with disabilities have insufficient background knowledge and literacy skills, they are given mostly word-based problems to solve as an isolated piece of information, and asked to repeatedly practice mechanical problem solving skills in de-contextualized environments (Gersten & Baker, 1998; Gersten et al., 2006; Hasselbring & Moore, 1996).

Such an instructional approach can make it difficult for students to understand concepts and their relationships in diverse contexts and to know how and when to use them to apply to an authentic situation (Gersten & Baker, 1998; Gersten et al., 2006; Hasselbring & Moore, 1996). Thus, when instructions are given in a meaningful contextualized learning environment, students may be capable of understanding and applying relationships of key concepts embedded in realistic problems and be able to grasp how the isolated parts of concepts fit together in an authentic situation to be applied (Goldman et al., 1996).

Rationale for the Study

Situated learning has emerged as a promising instructional approach in the field of education (Bransford, Vye, & Bateman, 1999; Bottge & Hasselbring, 1993; Gersten et al., 2006; Hasselbring & Moore, 1996; Young, 1993). Its premise is that if subject-matter knowledge is taught in a meaningful, realistic context and connected with people's everyday knowledge, it will be understood well. Such knowledge will become more functional for people trying to solve complex problems embedded in diverse situations (Greeno, Collins & Resnick, 1996, Vygotsky, 1978; Wilson & Myers, 2000).

Situated learning considers that learning occurs in the process of a learner's active participation in social activities or interactions with environments, and is accelerated by problematic situations (Greeno et al., 1996; Wilson & Myers, 2000). For example, an individual can construct knowledge during the collaborative discourse process in group activities (i.e., participation in social activities) or in-depth exploration to find significant information from the physical environment in individual inquiry (i.e., interactions with environments); learning can be facilitated by problematic situations as an individual solves a problem embedded in a purposefully complex and realistic situation.

Thus, an individual's active role is crucial to his or her learning. In particular, situated learning entails students' 'interdependent interactions' between the social and individual levels as well as 'co-collaboration' within discourse communities, rather than just interactions with their peers (Wilson & Myers, 2000; Young, 1993). In other words, merely joining in a group project or being in a learning environment does not mean that the person is learning. Rather, a learner must actively participate in social activities in learning communities by discussing, negotiating, or debating shared issues. Similarly, at the individual level, he or she must actively interact within a learning environment with ownership of an inquiry to learn.

The general characteristics of situated learning are: (a) student-centered learning, (b) small group activity, (c) role of teachers as facilitators or guides, (d) authentic problems provided at initial stages, (e) embedded essential knowledge and skills in problems necessary for problem solving, and (f) knowledge construction through self-directed learning (Barrows, 1996; Young, 1993). Such active participation in learning communities and interactions with realistic environments should enable students to acquire not only essential knowledge but also practical knowledge that can be transferred to other, similar situations (Greeno et al., 1996; Gersten et al., 2006; Wilson & Myers, 2000; Young, 1993).

Although the critical features of situated learning are applying knowledge to solve complex problems embedded in an authentic situation and transferring it to new, though similar, situations (CTGV, 1992; Mayer, 2002; Young, 1993), little is known about the effectiveness of situated learning on students' performance in terms of the level of knowledge transfer (i.e., knowledge acquisition, application, and transfer).

An important concept in situated learning is knowledge transfer. Knowledge transfer refers to carrying over prior knowledge to new situations (Greeno et al., 1996; Haskell, 2001; Wilson & Myers, 2000). The extent to which an individual transfers knowledge to a new situation is different. Haskell (2001) classified transfer into six levels based on the judgment of similarity between original and new learning (e.g., nonspecific transfer, near transfer, displacement or creative transfer and so on), and then later categorized them into three areas: (a) simple learning, (b) knowledge application, and (c) knowledge transfer.

In situated learning, through the practice of combining previous knowledge and skills with realistic situations, students are expected to know how, when, and where to use their prior knowledge to transfer it into a new, authentic situation. Previous research revealed that situated learning enhances students' knowledge application to an authentic situation (e.g., Ferretti, MacArthur, & Okolo, 2001; Williams, Brown, Silverstein, deCani, 1994), knowledge transfer to a new, similar situation (e.g., Bottge, Heinrichs, Mehta, & Hung, 2002; Fuchs, Fuchs, Prentice, Burch, Hamlett, Owen, Hosp, & Gancek, 2003a), and knowledge acquisition (e.g., Gersten, Baker, Smith-Johnson, Dimino, & Peterson, 2006; MacArthur, Ferretti, & Okolo, 2002; Mastropieri, Scruggs, Mantzicopoulos, Sturgeon, Goodwin, & Chung, 1998).

Contrary to the findings, however, some research reported that while students taught in situated learning contexts outperformed those in traditional intervention on knowledge transfer, there was no difference between groups on knowledge acquisition (e.g., Bottge, 1999; Bottge et al., 2002; 2004). On the contrary, Williams and his colleagues (1994) reported the effectiveness of situated learning on students' knowledge acquisition, but no significant difference between situated learning and conventional learning on knowledge transfer. Therefore, investigation is needed to determine whether situated learning produces different effects with respect to students' knowledge acquisition, application, and transfer.

In addition, research on situated learning in the field of education has mainly focused on adult learning, gifted-child education, and higher education (i.e., teacher education, college-level education, medical education). Relatively few studies have investigated the impact of situated learning on students with disabilities. In the research, 'anchored instruction' which was developed by the Cognition and Technology Group at Vanderbilt (CTGV) in the early 1990s is a variation of situated cognition and was implemented for students with and without disabilities in K-12 classroom settings.

Anchored instruction has the essential characteristics of situated learning (Bransford et al., 1999; Choi & Hannafin, 1995; Gersten & Baker, 1998; Young, 1993).

Most of all, it emphasizes the importance of constructing knowledge in meaningful and realistic situations. In "the Jasper Woodbury Problem Solving Series," a well-known anchored instruction program developed by CTGV, for example, students were given a set of complex problems embedded in video-based realistic situations and asked to solve the problems by combining previous knowledge in various areas (e.g., math, science, and history) with an authentic context. In particular, anchors that are embedded in the problem-rich environment take important roles in students' learning. They provide not only essential knowledge and skills students must learn, but also a shared context in which students can communicate with each other in learning communities and interact with a meaningful learning environment for an inquiry.

The previous studies reported that anchored instruction enhances students' interactions with teachers and their peers (Glaser, Rieth, Kinzer, Colburn, & Peter, 1999), basic computation skills, problem solving, and knowledge transfer in math (Bottge & Hasselbring, 1993; Bottge, Heinrichs, Chan, Mehta, & Watson, 2003; Bottge, Heinrichs, Mehta, Rueda, Hung, & Danneker, 2004; Bottge, Heinrichs, Mary, Mehta, Zara, & Hung, 2002; Bottge, Heinrichs, Mary, Shih, Serlin, & Ronald, 2001), critical thinking (Hur, 2001), motivation (Heo, 2008), word identification (Xin, Glaser, & Rieth, 1996), and levels and lengths of questions and responses in language arts (Rieth, Bryant, Kinzer, Colburn, Hur, Hartman, & Choi, 2003).

Despite the general effects of anchored instruction, little is known about the effectiveness of the instruction on the academic performance of students with disabilities, who are included in general education classrooms (Bottge, Heinrichs, Mehta, & Hung, 2002; Woodward, 2004). According to Woodward (2004),

> A problem with anchored instruction is that the precise nature of the skills and concepts learned in context are underdescribed in the literature. One typically reads extensive accounts of the problem-solving environments, but precisely how and to what degree students learn relevant skills and concepts remains vague. (p. 24)

Bottge and his colleagues have also questioned the effect of anchored instruction on the academic achievement of students with disabilities included in general education classrooms (Bottge et al., 2002). They inferred that too much or too little help from peers without disabilities in group activities may affect the performance of students with disabilities in anchored instruction.

In quasi-experimental design studies, since only a small number of students with disabilities are included in each comparison group, it has been hard to analyze the effects of anchored instruction on the academic achievement of such students. In this study, therefore, a meta-analytic statistical approach was adopted for the investigation. A meta-analysis is a systematic, quantitative review of the existing literature to integrate the effectiveness of an intervention (Cooper & Hedges, 1994; Rosenthal, Hoyt, Ferrin, Miller, & Cohen, 2006). Therefore, this advanced statistical review is expected to analyze the effects of situated learning on a small number of the population's performance.

Statement of the Purpose

The purpose of the study was to examine the overall effectiveness of situated learning on academic achievement of students with and without disabilities in inclusive general education classrooms. The study adopted a meta-analytic statistical approach with the following steps: First, the findings of the primary studies were classified, based on Haskell's model, according to the level of knowledge transfer: (a) knowledge acquisition, (b) knowledge application, and (c) knowledge transfer. Second, the effects of situated learning were examined according to the three levels of knowledge transfer using meta-analysis. Then, the disability composition of the sample was used as a predictor variable to explain differences in effect sizes.

The research questions guiding the study were as follows:

1. What are the effects of situated learning on students' placed in inclusive general education classroom on (a) knowledge acquisition, (b) knowledge application, and (c) knowledge transfer?
2. As the proportion of students with disabilities included in general education classrooms increases, does the effectiveness of situated learning decrease according to (a) knowledge acquisition, (b) knowledge application, and (c) knowledge transfer?

CHAPTER 2: LITERATURE REVIEW

Situated Cognition and Learning

Situated learning is theoretically based on constructivist theory and requires learners to construct their own knowledge from active participation in social activities and interactions with learning environments. More importantly, it focuses on 'social construction,' the premise of which is that learning takes place in an ongoing social process. This process involves one's interpersonal communication and active participation through interactions with learning communities and the environment (Lave, 1991; Wilson & Myers, 2000; Young, 1993).

Knowledge in situated cognition is not a concrete concept. According to Wilson and Myers (2000), "Knowledge is not an object and memory is not a location. Knowing, learning, and cognition are social constructions, expressed in the action of people interacting within communities. Through these actions, cognition is enacted or unfolded or constructed; without the action, there is no knowing, no cognition" (p. 59). Thus, in situated learning, knowing something is neither retrieving some object from stored memory, nor just imitating a model exactly after a demonstration, but 'perceiving' and 'acting' in the process of social construction (Young, 1993).

As Dewey (1929) mentioned, "Our discussion has for the most part turned upon an analysis of knowledge. The theme, however, is the relation of knowledge and action; the final import of the conclusion as to knowledge resides in the changed idea it enforces into action" (p.245). A critical feature of situated learning resides in knowledge acquisition in a meaningful, realistic context, and then being able to transfer it to new situations. Thus, to accelerate students' learning, it is essential to provide 'problem situations in realistic instructional contexts' (Young, 1993). Through active participation in learning communities, students are expected to develop an expert learner's proficiency by following their general patterns in a process of problem solving (Brown, Collins, & Duguid, 1989).

Knowledge in Situated Learning

Knowledge Structure and Problem Solving

Knowledge types may be categorized in many ways according to different researchers or to diverse contexts. Anderson and his colleagues (2001) presented four types of knowledge in general, and combined them according to Bloom's taxonomy of educational objectives as follows: (a) factual, (b) conceptual, (c) procedural, and (d) meta-cognitive knowledge (Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Raths, & Wittrock, 2001).

First, factual knowledge refers to "the basic elements students must know to be acquainted with a discipline or solve problems in it" (Anderson et al., 2001; p. 29). This includes knowledge of facts, terminology, static information, or specific details and elements. Examples include, for instance, musical symbols of flat, sharp, natural, and double sharp. Second, conceptual knowledge refers to "the interrelationships among the basic elements within a larger structure that enable them to function together" (Anderson et al., 2001; p. 29). Examples include knowledge of classifications, principles, and theories such as the Pythagorean Theorem or Piaget's developmental theory.

Third, procedural knowledge is concerned with “how to do something, methods of inquiry, and criteria for using skills, algorithms, techniques, and methods” (Anderson et al., 2001; p. 29). Procedural knowledge would include, for example, subject-specific skills and algorithms, such as word-processing skills or whole-number division algorithm. Finally, the highest level of knowledge dimension is meta-cognitive knowledge. Such knowledge helps learners monitor and regulate their own cognitive processes; it refers to “knowledge of cognition in general as well as awareness, and knowledge of one’s own cognition” (Anderson et al., 2001; p. 29). Meta-cognitive knowledge would include, for example, strategic knowledge, self-knowledge, or appropriate contextual and conditional knowledge.

Sugrue (1993; 1995), in particular, provides a model of ‘cognitive components of problem solving,’ along with knowledge structure, meta-cognitive functions, and motivation. In this model, knowledge structure necessary for problem solving were categorized into three: (a) concepts, (b) principles, and (c) the links from concepts and principles to conditions and procedures for application.

The first knowledge structure, concepts, refer to “a category of objects, events, people, symbols or ideas that share common defining attributes or properties and are identified by the same name” (Sugrue, 1993; p. 9). Several concepts consist of principles in complex relationships among other concepts. Next, a principle is defined as “a rule, law, formula, or if-then statement that characterizes the relationship (often causal) between two or more concepts.” Principles can be used “to interpret problems, to guide actions, to troubleshoot systems, to explain why something happened, or to predict the effect a change in some concept(s) will have on other concepts" (Sugrue, 1993; p.9).

The third knowledge structure, applying to conditions and procedures, is about "a set of steps that can be carried out either to classify an instance of a concept or to change the state of a concept to effect a change in another" (Sugrue, 1993; p.22). To solve complex problems, students are expected to go through a series of steps. Students must learn the concept that constitutes a principle; they must understand principles as well as the underlying relationships among concepts; finally, to apply these principles, they must link them and the concepts to concrete conditions and procedures. Therefore, each knowledge structure represents an important building block of capacity for problem solving.

More importantly, for successful problem solving, knowledge structure should be considered on the basis of 'interactions' between knowledge (Scruge, 1995). As is often the case with a learning situation, a student possessing basic knowledge and skills may still not understand principles or rules due to a lack of knowledge about their relationships. By the same token, a student may grasp the concepts and principles but not know how, in a concrete situation, to apply them. For them to solve complex problems in a concrete situation, it is crucial that students combine domain-specific knowledge (i.e., concepts and principles) with meta-cognitive functions (i.e., how to operate on that knowledge) (Sugrue, 1995). In general, factual and conceptual knowledge constitute knowledge of "what," and procedural and meta-cognitive knowledge relates this knowledge to "how to" (Anderson et al., 2001).

Knowledge Transfer

In situated learning, the main interest in students' knowledge is about how to apply basic knowledge and skills to a realistic context and, beyond this, to transfer them to other, though similar, situations in everyday life. Contrary to other learning theories which mainly focus on knowledge acquisition in terms of individuals' internal mental processes or the nature of informational input/output process, situated learning differentiates subject-matter knowledge taught in classrooms from everyday knowledge applicable to the real world, and emphasizes transferring knowledge to new, realistic situations (CTGV, 1992; Hasselbring & Moore, 1996; Wilson & Myers, 2000).

Whitehead (1929) introduced the notion of "inert knowledge," such that a student who possesses inert knowledge is often able to recall the concept but, in realistic situations, is unable to apply it. It means that essential knowledge students acquire in classrooms cannot guarantee automatic transfer to authentic situations. Therefore, the main issue concerning knowledge in situated learning is not only about acquiring 'essential knowledge and skills' students should be taught in domain-specific areas, but also about activating inert knowledge into 'practical knowledge' to transfer them to realistic situations to solve problems.

Knowledge transfer refers to "how previous learning influences current and future learning and how past or current learning is applied or adapted to similar or novel situations" (Haskell, 2001; p. 23). It's not about a way of thinking, retrieving from memories, or processing information, but relates to 'carrying over prior knowledge to new situations' (Greeno et al., 1996; Haskell, 2001; Wilson & Myers, 2000). If something is recognized as being the same as something else in different contexts, it is relatively easy for people to transfer it to a new situation. Thus, transfer starts from perceiving ‘similarities’ between different contexts, and is accelerated by creating categories and concepts in general thinking structures based on these similarities (Druckman & Bjork, 1992; Haskell, 2001).

Knowledge transfer varies from simple transfer (e.g., playing piano and then playing accordion) to more complex one (e.g., inventing an instrument using the principle of vibration). In accordance with the extent of similarity, Haskell (2001) presented six levels of transfer as follows: (a) nonspecific transfer, (b) application transfer, (c) context transfer, (d) near transfer, (e) far transfer, and (f) displacement or creative transfer.

The first level, nonspecific transfer, is a basic level, more similar to the concept of learning process. In some respects, we can say that people are constantly transferring their knowledge and skills in everyday life, because nothing can happen repeatedly in exactly the same context or in the same way. In that light, every process of acquiring knowledge is mostly related to past learning (Anderson, Reder, & Simon, 1996; Haskell, 2001), it can be regarded as just ‘simple learning’ rather than transfer itself.

The second level, application transfer, refers to applying what an individual has learned to a specific situation, such as making PowerPoint slides after learning about a PowerPoint program. Third, context transfer occurs when people apply what they’ve learned to a slightly different situation. Compared to application transfer, it often relates to context change under the condition of taking the same learning tasks.

The fourth and fifth levels, near and far transfer, have in common in terms of applying previous knowledge and skills to new situations that are similar but not identical to the original learning. However, they differ according to the extent that the original and new learning contexts differ. For instance, near transfer occurs when a person divides a pizza into eight pieces using knowledge about division in arithmetic. Far transfer occurs when a person, on his way home, sees lightening and observes that it is caused by clouds discharging electricity.

Due to the subjectivity of the terms, however, it is hard to define what near or far transfer is precisely. As for the issue, Haskell emphasized the role of 'knowledge base' possessed by an individual. Since a near transfer for an expert may be a far transfer for a novice, determining whether something is near or far is heavily affected by the extent to which an individual already possesses a 'knowledge base' (Haskell, 2001).

The final level, displacement or creative transfer, refers to "transferring learning in a way that leads to more than the insight of "that is like this." In the interaction of the newly discovered similarity between the old and the new, a new concept is created" (Haskell, 2001; p. 30).

The six levels of transfer were classified based on the judgment of similarity between original and new learning. According to Haskell, however, early levels of transfer (i.e., levels 1, 2, and 3) cannot indeed be considered transfers. From a rigorous point of view, a significant transfer requires "the learning of something new" to make a transfer (Haskell, 2001). Thus, genuine transfer falls within the range of levels four through six, from near transfer to displacement or creative transfer. In this view, level 1 and 2 (i.e., nonspecific and application transfer) should be regarded as "simple learning" and level 3 as "knowledge application" rather than transfer (Haskell, 2001).

Compared to the level of transfer, knowledge structure (e.g., declarative, procedural, conditional knowledge etc.) is connected with 'types of transfer' relating to 'how, when, and where' transfer occurs (Haskell, 2001). For instance, if a person who can ride a bicycle is asked to ride a motorcycle, it is "procedural-to-procedural transfer." Moreover, if a person knows how to play the violin, such practical knowledge may help in learning a category of chordophone (e.g., harp, lyre etc.). In this case, it is considered as "procedural-to-declarative knowledge."

Based on such a knowledge structure, Haskell (2001) came up with 14 types of transfer (e.g., strategic transfer, conditional transfer, reversal transfer, and so on). In schools, considering the knowledge structure may help to understand types of transfer. More importantly, since insufficient knowledge can lead to inappropriate transfer, students are encouraged to have a sufficient knowledge base and practice regarding what an individual will apply or transfer to.

Instruction in Situated Learning

Assumptions about Instruction

Teachers' instructional decision-making consists of numerous variables such as instructional goals and outcomes, lesson content, students' attributes, ecological factors and so on (Bartelheim & Evans, 1993; Morrissey & Semmel, 2001). Reigeluth (1999) categorized several considerations teachers take into account in planning their instructions as follows: (a) the nature of what is to be learned (e.g., factual knowledge and the goals of instruction), (b) the nature of the learner (e.g., each student's prior knowledge, motivation and experience), (c) the nature of the learning environment (e.g., problem-based learning or multimedia-based learning), and (d) the nature of the instructional development constraints (e.g., the amount of time for planning and developing, and technology resources).

In particular, designing instruction for situated learning is so complex artifacts for teachers. Rather than just delivering instruction, teachers need to create a rich, meaningful context in which students can continually interact with other students to build their knowledge through social activities (Wilson & Myer, 2000; Young, 1993). The learning context includes "people, machines, design artifacts, environments, and other objects and agents that may interact to establish ecological problem-solving relationships. But context also includes a shared culture, understanding, and motivations (Young, 1993; p. 45)."

Young (1993) proposed four broad tasks required for teachers to design situated learning. They include (a) "developing proper generator set of situations, (b) providing scaffoldings that allows novices and experts to perform alongside one another, (c) skillful implementation within situated learning by recognizing their role or using technology to support students, and (d) integrating assessment to instruction so that the situation provides both instructional and assessment opportunities and information" (p. 56).

Moreover, Herrington and Oliver (1995; 2000) divided constitutive elements of instruction into three domains (i.e., the anchor, the learner and the implementation), and presented nine characteristics of situated learning for instructional design along with the domains: (a) authentic contexts, (b) authentic activities, (c) access to expert performances, (d) multiple roles and perspectives, (e) collaborations, (f) reflections, (g) diverse opportunities, (h) coaching and scaffoldings, and (i) integrated, on-going assessment.

First, an anchor should provide (a) authentic contexts reflecting the real world as a form of full context, (b) authentic activities so that students can actively explore and construct knowledge, (c) access to expert performances and the modeling of processes to follow, and (d) multiple roles and perspectives that each student can have.

Second, learners should be promoted to have (e) collaboration between students for higher-order thinking, (f) reflections focusing on their own thinking process to enable abstract concepts to be formed, and (g) diverse opportunities to articulate, negotiate, and defend their knowledge to make their knowledge being explicit.

Finally, as for the implementation of instruction, teachers need to provide (h) coaching and scaffoldings just in time to help students generate their knowledge in complex macro-contexts, and (i) integrated, on-going assessment during the instruction. To understand the sophisticated instructional features of situated learning, the next section examines instructional principles of anchored instruction, which is an illustrative example of situated learning that is suitable for students with and without disabilities in K-12 classrooms.

Anchored Instruction

Anchored instruction refers to a systematic multimedia-based instruction using video-segments as an anchor to generate students' knowledge (CTGV, 1992a). Through problem-based collaborative learning, students are asked to solve complex and realistic problems presented in the video-anchor, to construct essential knowledge in the real-world situation and finally to generalize it to any new situation.

Anchored instruction has critical features of situated learning (Bransford et al., 1999; Choi & Hannafin, 1995; Gersten & Baker, 1998; Young, 1993). First, the essence of anchored instruction is to create ‘a rich, shared environment’ using video anchor that allows students to solve realistic problems in a meaningful context, construct their knowledge with multiple perspectives through collaborative work, and transfer the knowledge into other, similar situation (CTGV, 1992a).

Second, the ultimate goal of anchored instruction is to help students become independent learners by allowing them to experience “some of advantage of ‘in-context’ apprenticeship training” (CTGV, 1992a; p. 294). The technique has students follow the way experts think and solve problems to understand why, when, and how to use various concepts and strategies to solve complex problems in realistic situations (CTGV, 1992b).

Finally, contrary to traditional instructions which mainly emphasize basic computation or retrieval of knowledge facts, anchored instruction focuses on how students can ‘apply their knowledge to solve realistic problems in a meaningful context.’ This focus counteracts the notion of “inert knowledge.” According to Whitehead (1929), people possessing inert knowledge are often able to recall it when asked, but are unable to apply it spontaneously in solving problems, even if it is relevant. Anchored instruction thus aims to help students not only construct essential knowledge (e.g., core concepts or principles) embedded in situations, but also transfer their inert knowledge into practical knowledge through problem-solving processes in realistic situations.

Implementation of Anchored Instruction

Broadly, anchored instruction has two stages (Pellegrino, Heath, Warren & CTGV, 1991). First, students are asked to solve major problems presented in the video anchor through group activities. In the process of identifying issues, activating their own ideas, and exploring more alternate ways to find the best solution of given problems through the collaborative work in groups, students are expected to construct essential knowledge needed to solve the problems, and to activate their inert knowledge to more practical knowledge that can apply the findings to realistic situation. Next, students are encouraged to apply the key concepts or principles they obtained in the first step to other similar but different situations. The goal of this stage is for the student to integrate their knowledge across the curriculum and transfer it to other contexts.

Specifically, the implementation of anchored instruction can be divided into five phases: (a) setting the stage, (b) watching the anchor and retelling, (c) segmenting, (d) characterization, and (e) student research and presentation (Rieth et al., 2003). First, students learn research skills needed for conducting student research and for giving presentations in the final phase. Second, the whole class is invited to watch the whole video anchor from beginning to end and then asked to retell the story in their own words. The realistic context that students share through the video anchor enables them to have a common experience to discuss and to develop future research questions to investigate.

In the third phase, students segment the video anchor into meaningful events through class-wide discussions. Then, the whole class is divided into small groups consisting of 4-5 members to analyze the main characters from the story and present them to the class. Finally, in the fifth phase, each group generates research questions related to the issues, conducts student research, and presents the findings to the class by using a multimedia program (i.e., Multimedia PowerPoint).

Instructional Principles of Anchored Instruction

The critical features of learning environment of anchored instruction can be characterized as a meaningful problem-based context, shared environment, and cooperative learning activities to enhance students' generative learning (CTGV, 1992b; Love, 2004). Specifically, the Cognition and Technology Group at Vanderbilt (CTGV) presented seven design features underlying "the Jasper Series," the most well-known anchored instruction program (CTGV, 1992a; 1992b). First, the anchor is designed as a video-based format to support complex comprehension. Second, the video anchor, rather than being a lecture on video, is a narrative format with realistic problems.

Third, each story is provided as a generative format so that students can identify problems to solve on their own. Fourth, all data needed to solve the problems are embedded in the video anchor. Fifth, problems in each video segment are designed to have purposeful complexity closed to the real world situation. Sixth, there are pairs of related adventures to encourage students to transfer their knowledge to other similar situations. Seventh, it provides opportunities for students to integrate their knowledge across the curriculum through the process of problem solving.

In this regard, how teachers can provide and use an anchor is crucial for effective anchored instruction. McLarty and his colleagues (1990) presented several guiding principles needed for teachers in selecting and developing an anchor. First, in order to choose an appropriate anchor, teachers should have clear instructional goals and match them with the potential anchor. Second, the anchor needs to be used for students to enhance shared expertise around the anchor and responsibilities for their own learning.

Third, the anchor should not only contain a meaningful context so that students can acquire essential knowledge in the real world situation, but it should also provide relationships so that students can link the acquired knowledge to solve complex problems. Fourth, during the instruction, teachers should be consistently aware of the anchor and its role to achieve goals and try to link it with other more traditional literacy-related activities by merging the anchor. Finally, teachers need to provide diverse opportunities for students to explore using the anchor to help them develop expertise and encourage them to share their ideas with others.

Since anchored instruction is implemented primarily through small group activity, there becomes the issue of how to evaluate an individual student's achievement, as well as the group results (Rieth & Colburn, 2003). While cooperative work can provide many advantages to students, each member of a group can experience differential benefits such that some groups performance better than others, or a student in a group receives too much or too little help from other students in the group (Bottage et al., 2002; Stockall & Gartin, 2002).

To address this, teachers need to carefully consider how to structure groups and provide appropriate scaffoldings to students before evaluating each student's performance (CTGV, 1992a). Bransford and his colleagues emphasize the importance of ongoing assessment as an integral part of learning environment when teachers implement situated learning like anchored instruction (Bransford et al., 1999). Young (1993) also indicated that the assessment of anchored instruction must become an "integrated, ongoing, and seamless part of learning environment" (p. 48). The critical features of anchored instruction needed for teachers to make an instructional decision appear in Table 1.

Scaffoldings for Students with Disabilities

For successful situated learning, McLellan (1991) presented six common features of instructional models as follows: apprenticeship, collaboration, reflection, coaching, multiple practice, and articulation of learning skills. To generate them, most importantly, teachers need to support students' active learning as facilitators by providing proper scaffoldings at the appropriate time.

Especially for students with disabilities included in general education classrooms, teachers need to give more deliberate consideration in designing instructions for success of the students' learning. For example, they need to consider students' entry levels in relation to instructional goals, level of task difficulties in the taxonomy, a way of monitoring students' progress, and provision of instructional accommodations or scaffoldings (Morrissey & Semmel, 2001; Stough & Palmer, 2003). Determining the utility of any given strategy or teaching alternative is the most critical element in teachers' instructional decision making (Morrissey and Semmel, 2001).

In particular, recent syntheses of research examining effective instruction for students with learning disabilities (Denton et al., 2003; Linan-Thompson, 2004; Paulsen, 2005; Vaughn, Gersten, & Chard, 2000; Swanson, 2001) counted 'explicit instruction' as

Table 1 *Goals and Instructional Principles of Anchored Instruction*

Categories	Principles
Goals	"independent learners" who can: (a) generate problems and solve them in a realistic situation (b) construct essential knowledge in a real situation & understand when, how, and why to use various concepts, skills and procedures to solve complex problems (c) activate inert knowledge to practical knowledge that can apply to real life (d) transfer knowledge to a similar but different situation
Anchor	proper generator set of situations problem-based, macro context authentic context & activities shared environment purposeful complexity of the problems multimedia-based, narrative format embedded data needed to solve the problems expert performance & modeling of process meaningful context & relationship for knowledge transfer integration of knowledge across the curriculum
Students' Learning	generative learning - identify & solve the problems active participation & interactions with environments multiple roles & perspectives collaborative & social activities apprenticeship & reflections articulate & explicit knowledge negotiation & discussion shared expertise & responsibilities
Teachers' Implementation	perceiving clear instructional goals & linking them to anchor merging anchor to traditional literacy-related activities coaching, monitoring & scaffolding provision of multiple practices and opportunities seamless & ongoing assessment as an integral part of environment

one of the promising instructional strategies yielding positive outcomes for the students, along with (a) small grouping consisting of 3 to 5 members, (b) combining of direct and strategy instruction, and (c) adjusting task difficulties to a student's level.

Especially for teaching complex concepts and higher-order thinking skills embedded in the general education curriculum to the students with learning disabilities (LD), instructional procedures and materials should be explicit so that the students clearly know what to do in their learning, rather than inferring from previous experience or others' doing (Gersten, 1998; Knight, 2002; Paulsen, 2005).

The distinct feature of explicit instruction is to provide 'clear instructional procedures or a series of steps' to students so that they can understand, remember, and master contents effectively and efficiently (Gersten, 1998; Knight, 2002). Rosenshine (1987) identified three major components of explicit instruction as (a) decomposing complex tasks into small steps, (b) providing explicit guidance during the students' initial practice, and (c) giving enough practice opportunities to students. According to Swanson (2001), moreover, explicit instruction's critical components are explicit practice, elaboration, and strategy cues. These components can be delivered through five major strategies: (a) providing an advanced organizer, (b) modeling essential concepts, (c) guiding practice activities, (d) giving intensive independent practice, and (e) allowing time to reviewing concepts (Paulsen, 2005).

More specifically, Gersten (1998) provided several guiding principles of explicit instructional strategies to scaffold learning of students with disabilities: (a) providing proper examples to exemplify concepts or problem-solving strategies, (b) modeling with proficient performance, (c) reminding students of critical steps to solve a given problem, (d) providing more explicit explanations of abstract relationships, (e) allowing students to verbalize their thinking, (f) letting students have frequent feedback from both teachers and students, (g) having students adequate practice and activities, and (h) structuring classroom so that students can actively participate in class activities.

Explicit Scaffolding Strategies

Although a growing body of research examined the effects of explicit instructional strategies for students with learning disabilities, it is hard to say that there is one exact set of principles for explicit instruction because the principles change across academic domains or according to teachers' instructional design principles (Gersten, 1998). Based on the previous literature, therefore, I summarized evidence-based explicit instructional strategies that teachers can use for students with disabilities to scaffold their learning along with five categories: (a) small steps, (b) model/modeling, (c) practice and activities, (d) feedback, and (e) structuring classroom.

Small steps Students with learning disabilities have short attention spans and give up too quickly doing tasks whenever they meet difficulties (Wong, Harris, Graham, & Butler, 2003). Therefore, teachers must consider the students' attention spans, current knowledge and skills, entry level of behaviors, degree of difficulties of tasks, and conditions resulting in students' frustration (Gropper, 1983; Morrissey & Semmel, 2001). To do this, teachers can administer separate pre-tests to the students before lessons to ensure their entry level or prerequisites needed for mastering new knowledge and skills.

Based on the information, teachers can divide long-term goals into several proximal goals and segment complex tasks into small, incremental steps. Such measures will allow teachers to present their lessons step by step with proximal but explicit goals (Gropper, 1983). The provision of advanced organizer in the beginning of the lesson help students predict what they will be taught in the classroom (Kim, Vaughn, Wanzek, & Wei, 2004). By seeing in advance the lesson's structure lesson, students will be able to draw on their background knowledge to link it to new topics.

During the lesson, teachers need to not only provide essential knowledge and skills explicitly but also emphasize them using various ways such as visual-display, verbal-description, physical-record, and explicit cues for note-taking (Knight, 2002). They can explain the relationships among concepts using acronyms, visual images, graphic organizers, or diagrams (Gersten, 1998; Knight, 2002). For instance, students can be encouraged to describe main ideas and details in the book with their own words, or to structure essential components of events using paraphrasing strategy or story grammar (Dimino, Taylor & Gersten, 1995). Using a story grammar checklist is a good example of explicit instructional strategy to enhance reading comprehension: First, teachers demonstrate how to obtain important information from a given text and how to organize it along with essential components of the story (i.e., setting/time, characters, problem, and solution). Then, students are asked to find essential information embedded in the story by filling in the story grammar checklist.

Model/Modeling Diverse models from the social environment can play meaningful roles in changing students' behavior, cognition, and attitude. Generally, people are more affected by the models having prestige, competent, and similarities with themselves, and this is especially true when students believe the modeled behaviors will produce the expected outcomes (Bandura, 2000). Models should be observable and emphasize key features of what students have to learn (e.g., differentiated colors, shapes, or sounds); good modeling of people premises that the model has clear and specific objectives to show important concepts and procedural skills.

Especially for the students with disabilities, teacher-modeling may be more effective than peer-modeling, because teachers can exaggerate the distinct features of key elements, provide appropriate feedbacks just in time, and check students' strengths and weakness directly through the modeling. Prior to modeling, teachers can introduce the purposes of modeling or the significance of specific learning strategies to students to stimulate their motivation (Bandura, 2000).

Practice and activity Just demonstrating target behaviors of teachers is not enough to teach students complex skills. Teachers must provide students opportunities of actually doing; they must also furnish guided practice and corrective feedback (Bandura, 2000). Through trial and error, students are expected to learn the procedures of doing and strategies of solving a given problem, as well as copy exactly what they've observed (Knight, 2002). Specifically, teachers need to first demonstrate an entire process before asking these students to do an independent work. Also, they should gradually invite students to help them complete the tasks, and then have students do it individually (Vaughn, Klinger, & Bryant, 2001). During the students' activities, teachers can encourage them to verbalize what they are doing or what they need to do for practice.

In addition, teachers should consistently monitor the students' activities to determine whether the size of unit of practice or level of task difficulties matches the students' level (Gersten, 1998). Students with disabilities may grow frustrated with too difficult or too easy of tasks. They are susceptible to being either overwhelmed or distracted, both of which lead to a loss in motivation. On the other hand, they are motivated by slightly challenging tasks. According to Margolis and McCabe (2004), a little bit challenging tasks (i.e., the level of intermediate difficulty), which requires students to make some efforts to complete, reported increasing students' motivation, because such tasks embolden students and generate in them a pride of competence.

Feedback Immediate and frequent feedback from teachers or peers encourage students with disabilities to maintain their attention during the lesson and to take part in class activities (Knight, 2002). Feedback should be provided to students with enough time for them to respond and with sufficient opportunities for them to try (Knight, 2002). For this, it is recommended for teachers not to make more than three statements when they give feedbacks so that students can have enough time to think over the tasks.

In addition, timely feedback comes from teachers who monitor students' performance consistently. Especially in general education classrooms that include students with disabilities, teachers can use students' individual worksheet or portfolios to monitor and reinforce their progress. According to Margolis and McCabe (2004), teachers' praise of students' progress (e.g., persistence on tasks or efforts to use learning strategies to solve given tasks) can positively affects students' motivation by making them attribute their results to more controllable factors.

Structuring classroom A safe and supportive learning environment is the basis on which students with disabilities actively participate in learning with their general education peers (Gersten, 1988). One system that provides this basis is “high-access instruction,” proposed by Feldman and Denti (2004). Here students with disabilities can gain high access to the class-wide learning activities in general education classrooms and are provided several practical strategies. For example, since students with disabilities may need more time to think of answers to questions, they easily can be denied such time by students who blurt out answers. So, teachers can ask all students to have 40-50 seconds of silent time after asking a question so that all the students have thinking time. In addition, teachers can ask students for a thumps-up if they know the answer; they can ask students to write down their thoughts or questions on a card to be submitted after class. By utilizing such strategies, teachers can monitor their lessons efficiently and provide accessible lessons to all their students.

Especially for group activities, teachers’ deliberate considerations for structuring groups is crucial. Although collaborative group activity is known to be an effective instructional method for students with learning disabilities (Gersten, 1998; Vaughn et al., 2000), excessive or a little help from the peers without disabilities in the group may interfere with their learning. To promote positive interactions among students, therefore, teachers should clarify, with detailed guidelines, the roles and responsibilities of each group member. Also teachers must provide ongoing support so that all of the members can play a meaningful role in the group.

Anchored Instruction Interventions

To examine practical instructional design principles used by classroom teachers in implementing anchored instruction and the scaffolding strategies that were applied for the learning of students with and without disabilities in inclusive classrooms, the literature review on anchored instruction was conducted. A total of 8 articles were identified and all were published in peer-reviewed journals from 1993 to 2007 (see Appendix A). The overall characteristics of the studies were analyzed first, and each study's (a) participants and setting, (b) research design, (c) outcome measures, (d) instructional procedures of anchored instruction with used video anchor, and (e) results were summarized in the Table 2. Then, teachers' instructional design principles in implementing anchored instruction and scaffolding strategies used for students with and without disabilities were analyzed.

Participants and Settings

The eight studies included a total of 492 participants, and 21% of the students were students with disabilities (n=104). Aside from two studies conducted on high school for 9th grade students (Bottge & Hasselbring, 1993; Rieth et al., 2003), all of the participants were middle school students (6th grade to 8 grade). Half (k = 4) were conducted on 8th grade students (Bottge et al., 2001; Bottge et al., 2003, Bottge et al., 2007, Glaser et al., 1999). All interventions were implemented in regular classrooms including students with high-incidence disabilities (i.e., learning disabilities, mild mental retardation, and behavioral disorders) and without disabilities. The curricular content of anchored instruction was mostly mathematics (k = 7) (Bottge et al.), language arts (Rieth et al., 2003), and integrated language arts and social studies (Glaser et al., 1999).

The teachers lectured and led class-wide discussions; students were asked to work

Table 2 *Previous Literature on Anchored Instruction*

	Study	Participants & setting	Research Design	Outcome Measures	Implementation of Anchored Instruction	Results
1	Bottge et al. (2001)	75 middle school students (8th grade; 19 disabilities)	- T: Two EAI groups (RM & PA1 class); Video-based problem solving & Applied problem solving in technology classroom for 12, 90 min. class periods - C: Two TPI groups (PA2 & PA3); Typical, word-based problem solving & Applied problem solving (planning 2 week trip); teacher-led discussions & small-group project planning	(a) Computation (fractions & decimals) (b) Problem solving (c) Improvement (pre & post-test) (d) Maintenance	- Video Anchor: "Kim's Komat" - Steps: (a) watching the video anchor (b) identifying new concepts in the video anchor (c) students' work in pairs to solve problems, (d) working on advanced, applied problem solving in the real setting (technology ed classroom) * review time in the beginning of the class	- No difference b/w groups on maintenance test; No difference b/w PA students in EAI and TPI group - (a) Improvement: RM students' performance on problem solving posttest were not sig. different from PA students in both EAI and TPI group (matched); (b) PA students in EAI and TPI groups outperformed those in the RM class on computation tests (EAI: F(1,69)= 6,24, p<.01); TPI: (F(1,69)= 5.45, p< .02)
2	Bottge et al. (2002)	42 middle school students (7th grade; 8 disabilities)	- T: Two EAI groups; Video-based problem solving for 8 class days & related problem solving in technology classroom for 4 class days - C: Two TPI groups; Typical, text-based word problems & Applied problems for 12 class days; using mnemonic strategy	(a) Computation (fractions), (b) Text-based word problem solving, (c) Video-based contextualized problem solving, (d) Knowledge transfer	- Video Anchor: "Fraction of the Cost" - Steps: (a) watching the video anchor (b) summarizing the problems in the video, (c) lesson on how to operate the computer, (d) students' works in pairs to solve problems (e.g., navigated video anchor to find important information, or suggested tentative solutions), (e) applied problem solving in technology classroom	- No difference b/w groups on (a) fraction computation and (b) word problem solving test - Students in EAI group outperformed those in TIP group on (a) contextualized video-based problem solving (r=.81, p <.001) and (b) knowledge transfer (r=.62, p <.001)
3	Bottge et al. (2007)	128 middle school students (8th grade; 13 LD)	All are intervention groups (EAI) & repeated measures; Enhanced Anchored Instruction along with three different ability groups (a) inclusive, (b) pre-algebra, and (c) typical class for 24 class days	(a) Problem solving (b) Improvement (pre & post-test) (c) Maintenance	- Video Anchor: (a) "Kim's Komat" for Fall semester & (b) "Fraction of the Cost Instruction" for Spring semester - Steps: (a) watching video anchor without interruptions, (b) describing the problems associated with it, and (c) students' group works (2-4 members) to solve problems	- No difference b/w groups in (a) improvement and (b) maintenance - (a) Students of all three ability levels benefited from EAI: KKC (ES=.59, p<.001) & FFC (ES=.53, p<.001) on problem solving test; and (b) Improvement: lower scores of students with LD in inclusive group, but their learning trajectories matched those of students without LD

Table 2 (continued)

	Study	Participants & setting	Research Design	Outcome Measures	Implementation of Anchored Instruction	Results
4	Rieth et al. (2003)	62 high school students (9th grade; 14 disabilities)	All are intervention groups (AI); repeated measures; comparison b/w 6-week baseline condition (lecture with textbook) and 6-week intervention period (Anchored instruction) of two language arts classes.	(a) the length (long or short) and level (factual or interpretive) of questions asked by, and responses to student questions by, the classroom teacher, during a 50 min. class period. (b) the length and level of questions asked by, and responses made by, 9th grade students during a 50 min. class period.	-Video anchor: "To Kill a Mockingbird" - steps: (a) setting the stage,(b) watching the anchor/retelling,(c) segmenting, (d) characterization,(e) student research and presentations	(a) increased level and length of teacher questions, (b) increased numbers of student responses to questions, (c) increased student participation in learning activities, (d) increased school attendance, (e) more interactive instruction, (f) the demonstration of video as a powerful instructional tool, and (g) the demonstration of student research and reports as effective learning activities
5	Bottge et al. (2004)	93 middle school students (6th grade; 17 disabilities)	- T: Two EAI groups; Video-based problem solving & applied problem solving in technology classroom for a total of 7 months - C: Two TPI groups; Typical, teacher-led instruction, use 8 step strategy for solving word problems, class-wide discussion & independent worksheets * Additional individualized instruction for 4 students with disabilities from both control & treatment groups in sped resource room for 4 class days	(a) Fraction computation test (b) Word problem test (c) Video problem test (d) Transfer test	- Video Anchor: "Fraction of the Cost" - Steps: (a) watching video anchor (b) class-wide discussion led by teachers, (c) students' work in pairs, (d) group presentations	- No difference b/w groups in (a) fraction computation test - (a) Students in TPI groups outperformed than those in EAI on word problem test ($F(1,83)= 9.30$, $p=.003$); (b) Students in EAI groups outperformed than those in TPI on video problem test ($F(1,67)=17.32$, $p=.000$); and (c) on transfer test ($F(1,33)=6.98$, $p=.01$)

Table 2 (continued)

	Study	Participants & setting	Research Design	Outcome Measures	Implementation of Anchored Instruction	Results
6	Bottge et al. (2003)	37 middle school students (8th grade; 11 low achieving students; 7 disabilities)	3 intervention groups (LA1, LA2, AA); EAI & repeated measures under 3 conditions: (a) baseline, (b) video-based problem, and (c) applied problem instruction over 22 to 30 class sessions respectively	(a) Computation (b) Word problem solving	- Video Anchor: (a) "The 8th Caller" and (b) "Bart's Pet Project" - Steps: (a) watching the video from beginning to end with no interruption, (b) identifying challenge questions posed in the video and summarizing the problems, (c) modeling how to use the videodisc controller to search needed information, (d) students' group work to find best way to solve the problems, and (d) presenting the findings on the chalkboard	(a) The performance of all three groups was higher during anchored instruction than during the baseline condition (F(1,35)=11.77, p=.002); and (b) students in AA group outperformed those in LA group (t(35)=2.20, p=.03)
7	Glaser et al. (1999)	19 middle school students (8th grade; 9 disabilities)	One intervention group (AI): comparison b/w (a) baseline and (b) Intervention; 10 week intervention respectively for Fall (75 min. 28 class sessions) and Spring (55 min, 36 class sessions) semester	Frequency of teacher-student interactions on (a) task/directions/manageme nt interactions, (b) factual questions, (c) interpretive questions, and (d) teacher initiated lectures	- Video Anchor: (a) "To Kill a Mockingbird" for Fall semester; and (b) "Playing for Time" for Spring semester - Steps: (a) watching the anchor, (b) retelling and segmenting, (c) characterization, and (d) student research	(a) the average # of daily interactions b/w teachers and students increased, (b) the quality of questions asked by the teacher increased during large group discussions, and (c) students more attend school and less to engage in off-task or in socially inappropriate behaviors
8	Bottge & Hasselbring (1993)	36 high school students (9th grade; RM classes;17 disabilities)	- Before AI, all two remedial classes received an intervention with a videodisc program for only fraction-computation test - T: One contextualized-problem(CP) group; Anchored instruction for 5 class days - C: One word-problem (WP) group; Typical, teacher-led instruction for 5 class days	(a) Fraction-computation (b) problem solving (c) knowledge transfer	- Video Anchor: "Bart's Pet Project" - Steps: (a) watching the video anchor one time with no interruption, (b) describing challenge presented by the video, (c) discussing steps in the problem solving process, (d) teacher-guided quiz to check relationships b/w sub-problems and the challenge problem, (e) discussing ways to solve the problem, and (f) thinking about "what if" questions	(a) students in RM class showed significant difference on post-test of fraction-computation (t(30) = 3.12, p<.01), (b) Both groups of students improved their performance on solving word-problem test (F(1,27)=11.46, p<.01), (c) c. Contextualized problem group sig. better on the contextualized problem posttest (F(1,27)=8.79, p<.01), and (d) e. Contextualized problem group sig. better on contextualized transfer test (x(1, N=52)=5.85, p<.05)

on independent worksheets and solve word-based problems. In one study (Bottge et al., 2004), five 50 minute individualized instructions were additionally implemented in a special education resource room. This was done for four students, from both condition and treatment groups, with disabilities. Most interventions lasted between ten and twelve class sessions (k = 7); one lasted for 5 class days (Bottge & Hasselbring, 1993). Three of the studies conducted yearlong studies, where anchored instruction was implemented for two semesters (i.e., fall and spring semesters), twelve sessions respectively with different video anchors (Bottge et al., 2003, Bottge et al., 2007, Glaser et al., 1999).

In one study a language arts teacher implemented anchored instruction (Rieth et al., 2003). In the others multi-teachers (e.g., classroom teacher, special education teacher, technology teacher, research assistant of the study) worked cooperatively at implementing anchored instruction.

Effects of Anchored Instruction

Across the studies, the effects of anchored instruction were reported in seven areas: (a) computation and word problem solving (Bottge & Hasselbring, 1994; Bottge et al., 2003; Bottge et al., 2007), (b) video-based problem solving (Bottge & Hasselbring, 1993; Bottge et al., 2002; Bottge et al., 2004), (c) knowledge transfer (Bottge & Hasselbring, 1993; Bottge et al., 2002; Bottge et al., 2004), (d) improvement on problem solving performance of students with disabilities, which learning trajectories of students with disabilities were matched those of students without disabilities (Bottge et al., 2001; Bottge et al., 2007), (e) interactions between teachers and students (Glaser et al., 1999; Rieth et al., 2003), (f) the length and level of questions asked by, and responses to student questions by, the classroom teacher (Glaser et al., 1999; Rieth et al., 2003), and, finally, (g) the length and level of questions asked by, and responses made by, students (Rieth et al., 2003).

Students were reported to be participating in learning activities with highly pleasure and expending more effort at solving problems (Bottge et al., 2003; Glaser et al., 1999; Rieth et al., 2003). During the anchored instruction period, they also reported not only attending class more often, but also being less engaged in off-task or challenging behaviors (Glaser et al., 1999; Rieth et al., 2003).

Anchors

The anchors in the studies were all multimedia video-based anchors. A total of six different video anchors were used in eight studies. Two anchors were commercial videodisc or television movie (i.e., "To Kill a Mockingbird," and "Playing for Time"), three were researcher-developed videodiscs (i.e., "Fractions of the Cost," "Bart's Pet Project," and "The 8th Caller") and one was an episode in a series of video-based anchors called "The New Adventures of Jasper Woodbury" developed by CTGV in 1997 (i.e., "Kim's Komet").

They contained purposefully complex and realistic problems to be solved and provided background information and embedded data related to solve the problem in authentic context. For example, in "Fraction of the Cost," the mission was to see how three friends in the video could build, with all they have (i.e., money and materials in their houses), an affordable skateboard ramp. Students were asked to find the most economical way to build the ramp. To solve the problem, students were required to know how to read a bank account statement, calculate percentage of money in savings account and sales tax on a purchase, compute mixed fractions with different denominators, convert feet to inches, and construct a table of materials. The screen frame number in the video anchor helped students find and keep track of relevant information.

Instructional Steps

There were four instructional steps common to all eight studies: (a) watching the video anchor one time without interruption, (b) retelling or summarizing contents of the video, (c) describing problems presented in the video, and (d) students' group work to solve the problems. Overall, the instruction was implemented in a way of combination of class-wide and small group activities.

There were other instructional steps: (a) segmenting and characterization, which is to divide the movie into meaningful scenes and exploring a chosen character in terms of the stories' contents (Glaser et al., 1999; Rieth et al., 2003), (b) student research and presentation (Bottge et al., 2003; Bottge et al., 2004; Glaser et al., 1999; Rieth et al., 2003), (c) a lesson on how to use a videodisc or computer for student research (e.g., navigated video anchor to find important information) (Bottge et al., 2002; Bottge et al., 2003; Rieth et al., 2003), (d) teacher-guided warm-up time to review concepts learned on previous days or quizzes to check relationships between sub-problems and the challenge problems (Bottge & Hasselbring, 1993; Bottge et al., 2001; Bottge et al., 2003; Bottge et al., 2007), and (e) applied problem solving after video-based problem solving stages (Bottge & Hasselbring, 1993; Bottge et al., 2001; Bottge et al., 2002; Bottge et al., 2003; Bottge et al., 2004; Bottge et al., 2007).

Students' Learning Activities

In all eight articles, students watched video anchor first, and were invited to not only retell what happened in the video, but also identify issues and problems presented in the video. To solve the problems, they generated strategies using background information from the video as well as their basic knowledge and skills. In the process of problem solving, students shared their ideas and tentative findings with other classmates, and consistently debated or negotiated findings with other students to find the best solution or alternative way to solve.

In addition to solving the given problems, students conducted their own research. They developed research questions that reflected their personal interests, searched necessary resources from the library or the Internet, and, finally, presented their findings to classmates using multimedia software program such as PowerPoint or HyperStudio (Glaser et al., 1999; Rieth et al., 2003). They also proved their hypothesis directly through hands-on activities (Bottge et al., 2001; Bottge et al., 2002; Bottge et al., 2004; Bottge et al., 2007).

Generally, students, during the anchored instruction, participated in class-wide discussions or small group activities. In three studies, students worked in pairs (Bottge et al., 2001; Bottge et al., 2002; Bottge et al., 2004), and, in the other studies (k = 5), students worked in small groups of three to five members.

Teachers' Instructional Design Principles

Overall, teachers implementing anchored instruction focused on teaching 'concepts' and the 'relationships' between them. For instance, teachers in the condition group directly taught formulas needed to solve the given problem; teachers in anchored instruction presented no exact formulas. Instead, they explained how the concept of miles per hour related to feet per second, or how the concept of distance, rate and time are related to each other (Bottge et al., 2001). They reviewed concepts the students had been taught before and introduced them to new concepts related to the problems.

To check students' understanding, teachers consistently monitored students' progress during the instruction and provided intermittent feedback to the students. The frequent monitoring way of teachers mentioned in the studies was circulating from group to group (Bottge et al., 2001; Bottge et al., 2002; Bottge et al., 2007; Rieth et al., 2003). In three studies, teachers used students' individual folders containing (a) pieces of paper for the computations, (b) important information and related frame number of video scenes, and (c) a packet of workbook exercises to monitor students' learning progress, and re-teach if necessary (Bottge & Hasselbring, 1993; Bottge et al., 2002; Bottge et al., 2003).

Teachers in anchored instruction considered students' 'procedures to answers' as a part of learning and encouraged even partial participants. For instance, if a student showed a correct procedure but a wrong answer, they would get one out of two points (Bottge & Hasselbring, 1993; Bottge et al., 2003; Bottge et al., 2007). Through this 'partial credit' policy, 91% of the students with learning disabilities reported receiving at least partial points (Bottge et al., 2007).

Across the studies, the activities shown by teachers were to facilitate classroom conversations, provide resources (e.g., newspaper clippings, supplementary video clips), prompt students to develop their works, or coached small groups along with the problem-solving strategies they chose. For instance, when students had questions, teachers encouraged students to go back to the scenes in the video to find relevant information (Bottge et al., 2002); or when students reached reasonable problem-solving strategies, teachers let them show their solutions on the chalkboard (Bottge et al., 2003).

Simultaneously, teachers also directed the flow of instruction with guiding questions. At the beginning of the lesson, they introduced objectives for the day and reminded students of the concepts they had learned previously to help them link previous knowledge to new. Specifically, teachers encouraged students to have individual thinking time before class-wide discussion (Bottge et al., 2003), or clarified students' ideas by asking them to record their thinking on sentence strips (Rieth et al., 2003).

At the end of the anchored instruction period, teachers challenged students to transfer their knowledge to new situations. For instance, a teacher would ask "what if" questions to students to think about how solutions they obtained might be altered, given a new situation (Bottge & Hasselbring, 1993), or how they might use their strategies to solve future problems (Bottge et al., 2003).

Scaffoldings for Students with and without Disabilities

In most studies, teachers helped students' understanding during the instruction by consistently reviewing concepts, relationships, or basic academic skills (e.g., relationship between time, distance, and rate). Specifically, three studies had a warm-up time during the first 10 minutes of every class to help remind students of what they had learned previously, solidifying their understanding (Bottge et al., 2001; Bottge et al., 2003;

Bottge et al., 2007). In the other studies (k = 4), teachers reviewed the important elements discussed before, when necessary.

During the anchored instruction, teachers encouraged students to depict their ideas or tentative findings to the classmates. Through this, teachers made students have their own thinking time before class-wide activities, and checked students' understanding and learning progress. After students showed their work, they could do the next assignment. For instance, after watching the video anchor, students were asked to identify events or scenes essential to their understanding and record them on sentences strips (Rieth et al., 2003). After discussing problem-solving strategies, teachers asked students to write down their solutions on the chalkboard (Bottge et al., 2003). Teachers gave their answers only when students' work was finished (Bottge et al., 2001). Or students could conduct their project in the technology education classroom only after getting teacher's approval of their problem-solving plan (Bottge et al., 2002; Bottge et al., 2007).

To support students' research, teachers visualized what students need to recall during the instruction and encouraged students to keep using it. For example, after students summarized what happened in the video anchor and recorded critical events or scenes on sentence strips, teachers posted them around the classroom so that students could recall the movie events (Rieth et al., 2003). Moreover, during the anchored instruction period, students had to keep reverting back to the video anchor using the frame number of the video scenes to find relevant information. To support students' individual search for the information, two studies adopted the use of an "information form," which contained (a) important information, (b) frame number of the video scene, and (c) calculation (Bottge et al., 2002; Bottge et al., 2003).

To scaffold students' activities, educators frequently used provision of clue, prompt, and teacher modeling. For example, teachers prompted, when needed, the "range of speeds which guarantee success" (Bottge et al., 2001), modeled how to use the videodisc controller to find scenes in the video anchor (Bottge et al., 2002; Bottge et al., 2003), or demonstrated how to divide the movie into meaningful scenes and name it with five segmenting strategies (Rieth et al., 2003).

In none of the eight studies was there much mention of how teachers provided specific scaffolding strategies, especially for students with disabilities. Bottge and his colleagues, in particular, implemented additional individualized instructions for four students with disabilities during the anchored instruction (Bottge et al., 2004). Over five days in a special education resource room, the students worked in pairs and received 50 minutes of video-based instruction with the same video anchor of "Fraction of the Cost." During that period, they received extra help and specialized computer-based learning, such as "color coded click-and-drag module." This was part of an effort to help them understand which lengths of wood on the CD were identical to the dimensions in the plan. The study reported that, "Four students with disabilities who received extra help on the video-based problem in the special education classroom improved their scores on the video test by almost 23 points" (p.10).

The purpose of this section was to examine teachers' instructional decision making principles used by teachers implementing anchored instruction in general education classrooms, and explicit instructional strategies employed for students with disabilities included in general education classrooms. Overall, the essential instructional steps of anchored instruction can be characterized as follows: identifying issues and problems in the video, solving problems presented in the video, and transferring knowledge into other, similar situations. During the instruction, students were invited to participate in combined class-wide discussion or small group activities.

More specifically, the instructional procedures indicated in the studies were these: (a) watch the video anchor one time without interruption, (b) retell and summarize what happened in the video, (c) identify issues and generate problems by segmenting or characterizing the video anchor, (d) check students' background knowledge or basic academic skills related to the issue, (e) set how to conduct student research and presentation, (f) solve problems by generating strategies, (f) student research and presentation, and (g) transfer knowledge into other, similar situations.

Instructional Principles included in Anchored Instruction

The instructional principles revealed in the studies can be summarized as follows: First, the focus of instruction in implementing anchored instruction was not asking students to memorize facts or formulas, but helping students understand concepts and their relationships. For this, students were encouraged to participate in class discussions or small group activities to construct their knowledge through the learning community. According to Young (1993), the notion of "knowing" in situated learning does not mean retrieving something from stored memory, but "perceiving and acting." Thus, students in anchored instruction are expected to construct their knowledge in the process of active participation in social activities in groups and their interdependent relationships.

Second, during the anchored instruction, teachers consistently checked students' understanding and monitored their learning progress. They provided intermittent feedback to students, and reviewed the important elements of concepts, when necessary. As Bransford and his colleagues indicated, the assessment of anchored instruction should be an integral part of learning environment (Bransford, Vye & Bateman, 1999). Hence, teachers in the studies considered students' procedural skills as part of learning, and counted their procedural knowledge as part of their assessment (Bottge & Hasselbring, 1993; Bottge et al., 2007).

Third, teachers encouraged students to have their own work and conduct independent research in order that students can drive their learning. They didn't take a lot of roles in the class, but were not passive in their roles as instructors. Teachers mostly facilitated student discussions, coached small group activities, modeled procedures of learning, and directed the flow of instruction by asking guiding questions. This is contrast with the traditional role of teachers that teachers usually assign specific tasks to students during the class and directly teach essential knowledge and skills to solve them.

Thus, for teachers, the focal point of teaching in anchored instruction was to create a "rich and safe learning environment." This would allow students to fully interact with the environment and willingly take risks without fear of being teased in participating in practices of discourse and cooperative work with others. According to Barab and Duffy (2000), in order to develop learning environment for communities of practice, teachers should consider that (a) students must have ownership of the inquiry, (b) their learning is achieved in the collaborative and social works (e.g., discourse and negotiating), (c) the learning context needs to be motivating, and (d) rather than simplify dilemmas in situations, teachers should support the learner by coaching and modeling of their thinking skills, (Barab & Duffy, 2000).

In seven studies that included teacher interviews, it was reported that during the anchored instruction students became highly motivated, actively engaged, and fully involved in group works. Teachers reported that students with disabilities had been very reluctant to cooperate with other classmates and refused to work in traditional class time. During the anchored instruction, however, they worked with others pleasantly, trying to complete their works, and in general showing much more effort (Bottge et al., 2003; Bottge et al., 2004; Glaser et al., 1999; Rieth et al., 2003). While previous research indicated that students with disabilities were characterized as being passive and less motivated in their learning (Margolis & McCabe, 2004), the data supported the conclusion that anchored instruction enhanced student participation and motivation.

Specifically, students reported liking three learning phases of the anchored instruction: watching the video anchor, segmenting, and completing research presentations (Glaser et al., 1999). They felt pride in taking charge of their research and presenting the research to others, enjoyed working with others, and, rather than relying on teacher direction, could see the big picture for themselves (Rieth et al., 2003). If students consider that the tasks are well matched to their own goals and useful for their living, students become highly motivated and committed to achieving the self-set goals (Bandura, 2000; Stipek, 1996). Therefore, allowing students to set their goals by initiating issues in the video and generating their own research questions can produce high goal commitment in anchored instruction.

In the studies, a video anchor played important role in creating a rich environment. Students liked watching it because it allowed them to “visualize” what they needed to know without reading text (Glaser et al., 1999; Bottge et al., 2003; Rieth et al., 2003). Even the students with reading difficulties showed high levels of understanding about the story in the video (Rieth et al., 2003). They were able to “see” the ideas in the video and form “mental models” (Glaser et al., 1999).

According to the literature, students with disabilities have difficulties in understanding the contents of the textbook due to their problems with reading and writing (De La Paz & MacArthur, 2003). In the studies, however, video anchors allowed all students to access to the content and to participate in relevant activities. Compared to the other types of anchor (e.g., photos or picture), the video anchor provided more rich and interactive contexts in ways that students could depart their questions and inquires from this ‘shared context,’ and anchor their basis of arguments on the video by frequently reverting back to the video.

Lastly, teachers consistently challenged students to link their existing knowledge to new information. During the instruction, students were encouraged to reflect on their background knowledge to a real-world situation, and finally transfer their knowledge to another, similar situation. In the synthesized studies, five studies employed hands-on activities for knowledge transfer in a technology education classroom (Bottge et al., 2001; Bottge et al., 2002; Bottge et al., 2003; Bottge et al., 2004; Bottge et al., 2007), and one study implemented a “what if” question phase, after completing video-based problem solving tasks (Bottge & Hasselbring, 1993).

Scaffoldings for Students with and without Disabilities

As there are students with different level of abilities in general education classrooms, teachers need consider deliberately how to implement instructions for all students' learning. This study examined teachers' scaffolding strategies in anchored instruction along with the examples from the literature review (i.e., small steps, model/modeling, practice and activity, feedback, and structuring classroom).

First, there was time to review. Teachers provided it regularly or intermittently to check whether students had the basic academic skills needed to solve given problems. These moments were also used help students understand concepts and their relationships. They regularly set 10 minutes of warm-up time at the beginning of each class to go over what students had previously learned, or provided intermittent review-time, when necessary. This review time also provided teachers information on students' entry level of learning or their learning progress. Since students with disabilities tend to give up doing tasks too quickly whenever they meet difficulties, teachers should consider their current entry level or prerequisites needed for participating in class activities (Gropper, 1983; Morrissey & Semmel, 2001).

Second, teachers encouraged students to continue to the next steps only after students showed their work to teachers or other classmates. For instance, students were allowed to conduct their research after getting teacher's approval of their problem solving plans (Bottge et al., 2002). Also, teachers would ask students to show their solutions on the chalkboard before conducting exact problem solving tasks (Bottge et al., 2003).

During this step, students can have a chance to explain their thinking process explicitly to others and to reflect on their existing knowledge. Moreover, by segmenting complex tasks into small, incremental steps, teachers are able to achieve their long-term instructional goals with several proximal goals (Gropper, 1983).

Third, teachers encouraged students to depict their ideas or tentative findings in various ways such as visual-display or verbal-description. For example, students were asked to identify critical events or scenes in the video anchor with their own words, and record them on sentence strips and then posting them around the classroom (Rieth et al., 2003). Compared to the traditional instructions where teachers mostly drive students' learning, this approach supported student-centered instruction in which students drive their learning with participatory interactions with teachers and other classmates during the class.

In addition, teachers adopted "information forms," which contained (a) important information, (b) frame number of the video scene, and (c) calculation to support students' research. Students were then asked to record essential information embedded in the video anchor by filling out the form (Bottge et al., 2002; Bottge et al., 2003). The examples of story contexts, visual display and explicit cues for note-taking emphasized essential elements of learning in complex tasks and structuring them. This in turn helped reduce cognitive overload for students (Knight, 2002; Mayer & Moreno, 2003).

Fourth, teachers frequently provided clues, prompts, and modeling to scaffold students' activities. In the modeling, for example, teachers demonstrated a series of steps about how to segment the movie into meaningful scenes and name it, along with five segmenting strategies, then asked students to do the tasks (Rieth et al., 2003).

According to Bandura (2000), modeling target behaviors is not enough to teach complex skills. Thus teachers need to provide students opportunities to actually do them, providing them with guided practice and corrective feedback. In anchored instruction, multiple opportunities of practicing learning activities were given to students across the phases. From retelling the story in the video anchor to presenting their research, students were invited to participate in groups in various activities. The immediate and frequent feedback from peers in the group can also facilitate students' maintaining their attention on the activities (Knight, 2002).

Across the studies, except for one that employed additional individualized instruction to students with disabilities (Bottge et al., 2004), there was little mention about scaffolding strategies especially designed for students with disabilities. However, there were scaffoldings for whom the chief beneficiaries were students with disabilities. First, students were allowed to respond to questions either "orally" or "by writing" the answer down on paper (Bottge & Hasselbring, 1993). Second, when students had the text-based word problem test, the reading level of the test was set at or below a 4^{th} grade reading level (Bottge et al., 2002; Bottge et al., 2003; Bottge et al., 2004). Third, for final group presentation, all of the group members divided workload so that everyone had a chance to contribute to the research presentation (Rieth et al., 2003).

These strategies can apply to the students with disabilities. Before implementing anchored instruction in general education classrooms, teachers should consider if there are students who have difficulties in reading or writing. For the students, teachers need to give them diverse opportunities to access questions (e.g., adjusting the reading level or questioning orally) and make them respond orally. For group activities, moreover, teachers can clarify roles and responsibilities that students can take for group works in advance, and encourage each student in the group to have his/her individual role and responsibilities so that all the group members including students with disabilities can meaningfully contribute to the group works.

Issues for Students with Disabilities in Anchored Instruction

In spite of the effectiveness of anchored instruction, there are issues to consider for students with disabilities. First, are students with disabilities deriving enough academic benefit from the anchored instruction? Especially for the studies implementing anchored instruction for math classes, the authors expressed their concerns about basic academic skills (e.g., computing fractions) of students with disabilities (Bottge et al., 2001; Bottge et al., 2002; Bottge et al., 2004). According to the studies, students with disabilities earned disappointing academic scores on computation test, and some students' computation skills even decreased during the instruction (Bottge et al., 2002). Moreover, one study revealed that a student with disabilities hardly participated in class-wide discussion because he couldn't add mixed numbers (Bottge et al., 2004).

Then, how are teachers who are implementing anchored instruction in general education classroom able to scaffold the learning of students with disabilities? As previous studies indicated (Bottge et al., 2002; Bottge et al, 2004), it is not sufficient for students with disabilities to receive small-group intervention. They need additional, individualized help with the cooperation of a general education teacher and a special education teacher. They need plenty of opportunities to try to do tasks and plenty of intensive independent work to learn (Gersten, 1998, Paulsen, 2005). So, to help their academic performance, teachers must provide an individualized approach to the students with disabilities (e.g., assigning an individual folder to each of student for daily practice).

Especially for teaching complex tasks or abstract concepts required higher-order thinking skills embedded in integrated curriculum, instructional procedures should be explicit (Gersten, 1998; Knight, 2002). In the cited articles, researchers suggest combining explicit instruction on procedural skills, direct instruction, and hands-on applications with anchored instruction (Bottge et al., 2002; Bottge et al., 2007).

According to Bottge and his colleagues (2001; 2002; 2004), too little or too much help from peers without disabilities in the group may cause low performance of students with disabilities in anchored instruction. The studies revealed that students with disabilities consistently asked other group members for answers to solve sub-problems, and depended a great deal on a more capable partner. Thus, in generating small group activities, teachers should structure the learning environment carefully in ways that help decide membership in a group and assign roles and responsibilities so that all members in the group take their roles meaningfully.

According to the literature, it is effective for students with learning disabilities to have small group instruction with 3 to 5 students (McCray, Vaughn & Neal, 2001; Vaughn et al., 2001). However, whether the peer members in the group have enough skills to explain their ideas to others, whether each group members can manage difficulties during the group activities, or to what extent proficient members teach less proficient peers in a group are different issues for teachers to consider in organizing group membership. In addition to this, how teachers can assess not only the group result but also an individual student's achievement is remaining task to solve for teachers in structuring group activities (Rieth & Colburn, 2003).

Moreover, students' background knowledge, task difficulties, and interests in the topic were regarded as factors affecting learning of students with disabilities and their participation in group activities (Bottge et al., 2002). To have this information, it is essential for teachers to monitor students' learning consistently through ongoing assessments. As Young (1993) mentioned the need of seamless assessment in anchored instruction as an integral part of learning environment, every students need to be provided multiple opportunities to make their thinking visible during the instruction so as to receive frequent feedback from others, and to revise their learning outcomes consistently through the seamless assessment.

In addition to monitoring students' learning performance, teachers need to check the level of task difficulties to decide whether the size of unit of practice matches to the students' level (Gersten, 1998). As previous research revealed, students with learning disabilities are characterized as having short attention span and showing negative signs to give up the tasks too quickly whenever they meet difficulties (Wong et al., 2003). Rather than being too focused on students' ability level during the instruction, therefore, teachers need to focus on tasks' difficulty level based on students' attention spans and current abilities, and consider whether they need to adjust task difficulties or break the tasks down into more small, incremental steps.

Conclusion

The instructional design principles used by teachers in the studies were revealed as follows: (a) the focus of instruction was to help students understand concepts and their relationships; (b) students were encouraged to participate in class discussions or small group activities to construct their knowledge in the process of active participation in social activities in groups and their interdependent relationships; (c) during the instruction, teachers consistently monitored students' learning progress, and provided intermittent feedback to them; (d) teachers considered students' procedural skills as part of learning and counted them as part of assessment; (e) teachers encouraged students to have their own work and conduct independent research so that students have the ownership of inquiry; (f) the focal point of instructional design was to create a 'rich and safe learning environment,' and a video anchor played an important role in it; (g) teachers directed the flow of instruction by asking guiding questions, but, mostly, played their roles as facilitators, coaches, models or mentors; (h) video anchors allowed students access to the content, provided shared context for discussions, and highly motivated students; and (i) teachers challenged students to link their existing knowledge to new information, reflect on their background knowledge to a real-world situation, and finally transfer their knowledge to another, similar situation.

Across the studies, there was little mention about scaffolding strategies especially implemented for students with disabilities, except provision of additional, individualized instruction during the anchored instruction for them. The scaffolding strategies employed for overall students were presented as follows: (a) teachers provided review time regularly or intermittently to check students' entry level or prerequisites needed for participating in class activities; (b) by segmenting complex tasks into small, incremental steps and checking students' tasks step-by-step, teachers encouraged students to achieve their ultimate learning goals; (c) to help students understand essential elements of learning embedded in complex tasks and structuring them, teachers employed various explicit strategies, such as visual-display, verbal-description, and explicit cues for note-taking (e.g., information forms); (d) teachers provided clues, prompts and modeling to facilitate students' procedural skills and learning activities; (e) across the phases of anchored instruction, students had multiple opportunities for practicing actual performance of learning, and teachers provided them with guided practice and corrective feedback, (f) for evaluation, teachers adjusted reading level of the word-based test below 4th grade level, or allowed to respond to questions orally, and (g) for group presentation, teachers made all of the group members divide their workload, so that everyone had a chance to contribute to the research presentation. Findings of the literature review regarding critical characteristics of situated learning are summarized in Table 3.

In sum, situated learning has emerged as a promising instructional approach in current education reform movement, which requires conceptual understanding to solve complex problems embedded in diverse contexts. Given a meaningful contextualized learning environment, students are encouraged to combine isolated pieces of knowledge with realistic problems in an authentic situation to be applied.

Although the distinct features of situated learning are applying knowledge to an authentic context and transferring it to new, similar situations, few studies have focused

Table 3 *Critical Characteristics of Situated Learning*

Categories	Instructional Principles	Critical Characteristics
Goals	"independent learners," who can: a) generate problems and solve them in a realistic situation b) construct essential knowledge in c) a real situation & understand when, how, and why to use various concepts, skills and procedures to solve complex problems d) activate inert knowledge to practical knowledge that can apply to real life e) transfer knowledge to a similar but different situation	**1. Conceptual understanding**: Instructional focus is to help students understand concepts and their relationships.
		2. Contextual learning in meaningful, authentic situations: Students construct their knowledge in a meaningful, authentic situation. So, creating a rich and safe learning environment is essential part of situated learning.
		3. Knowledge application and transfer: Students are encouraged to link their existing knowledge to new information, reflect their background knowledge on a real world situation, and transfer their knowledge to another similar situation.
Anchor/ Context	· proper generator set of situations · problem-based, macro context · authentic context & activities · shared environment · purposeful complexity of the problems · multimedia-based, narrative format · embedded data needed to solve the problems · expert performance & modeling of process · meaningful context & relationship for knowledge transfer · integration of knowledge across the curriculum	**4. Problem-based, macro context:** Students are asked to solve complex problems embedded in a realistic situation with data necessary to solve them. The problems have a purposeful complexity and may come from across the curriculum.
		5. Shared culture & background: Authentic situations can provide shared context to students. It helps students understand background information necessary for learning and facilitates participation in discussions.
Students' Learning	· generative learning - identify & solve the problems · active participation & interactions with environments · multiple roles & perspectives	**6. Knowledge in active participation; knowing by doing:** Students learn in a process of active participation in authentic activities. The learning occurs in active participation in contexts rather than in just hands-on activities.
		7. Interactions with learning environments; reciprocal influences between an individual and contexts: Knowledge is placed on 'interactions' b/w an individual and contexts (e.g., learning communities or environments);Learning occurs in reciprocal influences b/w an individual and contexts, rather than just an environmental effect.

Table 3 (continued)

Categories	Instructional Principles	Critical Characteristics
Students' Learning	· collaborative & social activities · apprenticeship & reflections · articulate & explicit knowledge · negotiation & discussion · shared expertise & responsibilities	**8. Social activities in learning communities; interdependent relationships in collaborative work; important role of discourse and negotiation:** Students are encouraged to participate in class discussions or small group activities to construct their knowledge in the process of active participation in social activities. Students have interdependent relationships in learning; discourse plays an important role in the activities.
		9. Ownership of inquiry; student-driven, independent research: Students generate their learning by identifying issues. Teachers encourage students to have their own work and conduct independent research so that students have the ownership of inquiry.
		10. Apprenticeship in social contexts: By observing experts' general patterns of learning process, students construct their knowledge in social contexts of apprenticeship. Students can share their own expertise and responsibilities during the learning.
Teachers' Implemen-tation	· perceiving clear instructional goals & linking them to anchor · merging anchor to traditional literacy-related activities · coaching, monitoring & scaffolding · provision of multiple practices and opportunities · seamless & ongoing assessment as an integral part of environment	**11. Scaffoldings in ZPD; Teachers as facilitators, coaches, models, or mentors:** Teachers direct the flow of instruction by asking guiding questions, but, mostly, they play some roles as facilitators, coaches, models, or mentors. Teachers provide multiple opportunities and practices necessary for scaffolding.
		12. Formative evaluation; seamless ongoing assessment as an integral part of environment: Teachers consider students' procedural skills as part of learning and count them as part of assessment. During the instruction, teachers keep monitoring students' learning progress and providing intermittent feedbacks to them.

on the effectiveness of situated learning on students' academic performances in terms of the level of knowledge transfer (i.e., knowledge acquisition, application, and transfer). Moreover, because the very small number of students with disabilities are included in a general education classroom, little was known about the effectiveness of situated learning on the academic performance of the students with disabilities in this setting. Therefore, it is meaningful to investigate whether situated learning has differential effects on students' academic performances according to the level of knowledge transfer (i.e., knowledge acquisition, application, and transfer), and the disability composition of general education classrooms.

CHAPTER 3: METHOD

Research Purpose and Questions

The purpose of the study was to investigate the effect of situated learning on the learning of students with and without disabilities in inclusive general education classrooms. The research questions guiding the study were as follows:

1. What are the effects of situated learning on students' placed in inclusive general education classroom on (a) knowledge acquisition, (b) knowledge application, and (c) knowledge transfer?

2. As the proportion of students with disabilities included in general education classrooms increases, does the effectiveness of situated learning decrease according to (a) knowledge acquisition, (b) knowledge application, and (c) knowledge transfer?

Meta-analysis

This study employed a meta-analytic statistical approach for "the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings" (Glass, 1976; p. 3). It combines a group of empirical studies investigating similar researching questions and summarizes, with statistical values, the results of the primary studies. In such manner it attempts to create "generalizations" with an overall estimate of the relevant population effect size. Whereas a single primary study's results cannot provide full external validity for an intervention, meta-analysis allows researchers to perceive the general effect of an intervention across studies and samples (Hall, Tickle-Degnen, Rosenthal, & Mosteller, 1994).

This study followed the four steps to the methodological process as recommended in *The Handbook of Research Synthesis* (Cooper & Hedges, 1994): (a) the problem formulation stage, (b) the data collection stage – searching the literature, (c) the data evaluation stage – coding the literature, and (d) the analysis and interpretation stage.

Stage 1: Problem Formulation

The first step of a meta-analysis is to formulate the problem. During this stage, a meta-analyst generates issues that can mediate the diversity of the relevant studies and formulate theoretical hypothesis that a single primary study has never tested (Cooper & Hedges, 1994). The purpose of the stage is to derive specific research questions from the formulated problems. In this study, I provided the rationale for the study and, based on the literature review, proposed two research questions. A brief explanation of this is as follows:

In the literature on situated learning, the precise nature of knowledge and skills that students learned in the context of situated learning is vague (Bottge et al., 2002; Woodward, 2004). Many studies have reported the effects of situated learning in socio-emotional areas (e.g., motivation, self-efficacy, and interactions). Yet no convincing evidence has been offered to demonstrate that situated learning improves students' academic performance. In particular, I found no tests in a primary study showing that situated learning affected differentially the level of students' knowledge transfer.

Moreover, situated learning's effect on students with disabilities could hardly be analyzed in experimental design studies conducted in inclusive general education classrooms; as only a very small number of students with disabilities are typically assigned to each comparison group. The insufficient sample size increases sampling error and reduces the associated power. Therefore, tests of the effects of situated learning on academic performance of students with disabilities who are included in a general education classroom with a small number might be under powered.

In this regard, a meta-analysis is an effective methodological approach to answer the questions of this study. As a statistical research integration method, it should provide an estimate of the general effectiveness of situated learning regarding students' academic achievement and examine whether the effectiveness is related to the level of knowledge transfer of students and to the disability composition of general education classrooms.

Stage 2: Data Collection

Literature Search

The overall search procedure of this study had three steps. First, a systematic electronic search was conducted using online data base services, such as PsychoINFO, ERIC, Academic Search Complete, and PsycARTICLES. The input keywords used for the search were: *situated learning/situated cognition, context-based, contextual learning, real-world, real-life, problem-based learning, project-based learning, problem solving, anchor, anchored instruction, authentic tasks, reciprocal teaching, transfer, discourse, computer, video, inclusive, classrooms, and disabilities*.

This study included both published and unpublished studies to prevent publication bias. Thus, using the same keywords, I scanned ProQuest databases for dissertations and theses. Since the concept of situated learning or problem-based learning was introduced in the 1980s and 1990s, publication dates ranged from 1980 to 2011. While searching, I compiled a list of primary researchers who published articles mostly on situated learning, anchored instruction, or problem-based learning. Thus, additional electronic searches were made based on these authors' last names: Bottge, Bransford, Ferretti, Gersten, Greeno, Hasselbring, MacArthur, Mastropieri, Okolo, Palincsar, Scruggs, and Woodward.

Second, a hand search was conducted of the journals related to the issues of special education, general education (i.e., elementary and secondary education), and computer education. These journals included: *Exceptional Children, Focus on Exceptional Children, Journal of Special Education Technology, Remedial and Special Education, Journal of Special Education, Journal of Learning Disabilities, Learning Disability Quarterly, Learning Disabilities Research & Practice, Journal of Research in Special Educational Needs, Educational Technology Research and Development (ETR&D), The Elementary School Journal, Journal of Educational Technology System*.

Lastly, review articles or theoretical overviews of situated learning were gathered to review the references. This "snowball method" was also employed to review studies cited in the aforementioned articles. Collectively, these three searching procedures yielded more than 300 articles.

Selection Criteria

Several inclusion criteria were applied to determine the relevance of the potential articles to the issues of the study. First, the intervention characteristics of a study had to meet the criteria of situated learning (e.g., contextual learning in meaningful, authentic situations, knowledge in active participation, social activities in learning communities, and student-driven, independent research), which were previously developed by the author in the literature review (see Table 3).

If a study did not meet at least one of the components of the characteristics, it was excluded. Second, participants included in the study consisted of students both with and without disabilities enrolled in K-12th grade level classes. Third, since the study focuses on inclusive classes the intervention had to have been implemented in an inclusive general education classroom, rather than a resource room, a clinic, or a laboratory condition where students with disabilities are usually pulled out for an intervention.

Fourth, to be included, a study had to document a treatment difference using a statistical measure. To meet this criterion each study had to involve one of an experimental, quasi-experimental, or repeated-measures design. Fifth, the treatment effect of a study had to be measured using academic achievement data rather than motivation, self-efficacy, or interactions. Sixth, the study had to show methodological rigor. Gersten and his colleagues (2005) presented a set of quality indicators for evaluating experimental and quasi-experimental research studies. Using the quality indicators, each study was examined in terms of describing participants, implementation of the intervention and description of comparison conditions, outcome measures, and data analysis.

This study included both peer-reviewed journal articles and unpublished studies (i.e., dissertations, master theses, and technical report) to prevent publication bias. Publication bias has been one of the most frequently discussed and debated issues in meta-analysts. Because published articles are more likely to have a large effect size (and in turn, studies with a smaller or no effect are less likely to be published), conducting the meta-analysis only with published research studies would lead meta-analysts to reach biased findings to positive effects. Using all six of the above criteria, 28 articles were included.

Among the aforementioned articles, some were excluded because: (a) the study reported insufficient statistical information necessary to conduct meta-analysis (i.e., sample size, means, standard deviations, or appropriate *t*-test or *F* statistic results); (b) the study failed to describe whether students with and without disabilities participated in interactive activities or collaborative work together (e.g., group activities, discourse, or learning communities); (c) the study failed to report the number of students with disabilities participated in a study; (d) the intervention was mainly designed for individual learning using computer software or a web-based program; and (e) additional interventions (e.g., ad–hoc tutoring) were given only to the students with disabilities.

In sum, a total of 19 articles met all the criteria (see Appendix B) providing a relatively small number of articles. In fact, most of the research consisted of "anecdotal" piece of articles generating ideas or theoretical overviews, rather than experimental studies examining the effectiveness of situated learning. Moreover, situated learning interventions were mainly designed for select groups – high school students without disabilities, higher education at the college level or pre-service teacher education, or adult learning. When a study was designed for students with special needs, it was mostly implemented in non-inclusive settings such as resource rooms, self-contained classrooms, or special schools. Finally, while many studies reported the effect of situated learning on the domains of socio-emotional areas (e.g., motivation, self-efficacy, and interactions), relatively little research examined its effect on the academic achievement of students with disabilities. The selected articles' intervention characteristics related to situated learning are summarized in Table 4.

Stage 3: Data Evaluation

Coding Research

After the 19 studies were gathered, they were coded. This process identified variables of potential interest to review and then extracted the information from each study. The classified variables of diverse studies can lead to potential moderators that may explain variability in studies' effect sizes.

Generally, coding research can be categorized into two broad types: study characteristics and study findings (Lipsey & Wilson, 2001). Study characteristics are associated with independent variables; the factors that can affect an intervention's effect (e.g., sample demographics, settings, intervention). Study findings are related to dependent variables; the empirical data necessary for calculating effect sizes (e.g., sample size, mean scores, t-test statistics, etc.).

In particular, Stock (1994) introduced a set of categories for classifying items – report identification, setting, subjects, methodology, treatment, process, and effect size. Based on Stock's recommendations, this study developed seven categories of classification of items. More detailed explanations of each category and its components are as follows: (a) report identification – unique identification number, author, year, and

Table 4 *Intervention Characteristics of Selected Articles*

	Critical characteristics of situated learning / Synthesized articles	1) Conceptual understanding	2) Contextual learning in meaningful, authentic situations	3) Knowledge application and transfer	4) Problem-based, macro context	5) Shared culture & background	6) Knowledge in active participation; knowing by doing	7) Interactions with learning environments	8) Social activities in learning communities	9) Ownership of inquiry; student-driven, independent research	10) Apprenticeship in social contexts	11) Scaffoldings in ZPD; teachers as facilitators	12) Formative evaluation; ongoing assessment	Intervention characteristics
1	Williams et al. (1994)	v	v	v	v	v	v	v	v	v	v	v		themes instruction
2	Okolo & Ferretti (1996)	v	v	v	v	v	v	v	v	v	v	v		project-based learning; TAM
3	Dalton et al. (1997)	v	v		v		v	v	v	v	v	v	v	hands-on; supported inquiry-based learning
4	Mastropieri et al. (1998)	v	v	v	v	v	v	v	v	v	v			hands-on; inquiry-based learning
5	Bottge (1999)	v	v	v	v	v	v	v	v	v	v	v	v	anchored instruction; video
6	Bottge et al. (2001)	v	v	v	v	v	v	v	v	v	v	v	v	anchored instruction; video
7	Ferretti et al. (2001)	v	v	v	v	v	v	v	v	v	v	v		project-based learning; video; TAM
8	Bottge et al. (2002)	v	v	v	v	v	v	v	v	v	v	v	v	anchored instruction
9	MacArthur et al. (2002)	v	v	v	v	v	v	v	v	v		v		project-based learning; TAM

Note. The 12 categories are critical characteristics of situated learning categorized by the author through literature review. Detailed explanations are summarized in the Table 3. TAM = Team Approach to Mastery

Table 4 (continued)

	Critical characteristics of situated learning / Synthesized articles	1) Conceptual understanding	2) Contextual learning in meaningful, authentic situations	3) Knowledge application and transfer	4) Problem-based, macro context	5) Shared culture & background	6) Knowledge in active participation; knowing by doing	7) Interactions with learning environments	8) Social activities in learning communities	9) Ownership of inquiry; student-driven, independent research	10) Apprenticeship in social contexts	11) Scaffoldings in ZPD; teachers as facilitators	12) Formative evaluation; ongoing assessment	Intervention characteristics
10	Bottge et al. (2003)	v	v	v	v	v	v	v	v	v	v	v	v	anchored instruction
11	Fuchs et al. (2003a)	v	v	v	v		v		v		v	v		schema-based transfer instruction
12	Fuchs et al. (2003b)	v	v	v	v		v	v	v	v	v	v	v	schema-based transfer instruction; self-regulated learning
13	Bottge et al. (2004)	v	v	v	v	v	v	v	v	v	v	v		anchored instruction; video
14	Fuchs et al. (2004)	v	v	v	v		v		v		v	v		schema-based transfer instruction
15	Gersten et al. (2006)	v	v	v		v	v	v	v			v		documentary instruction; peer dyad activities; video
16	Fuchs et al. (2006)	v	v	v	v		v	v	v		v	v		schema-broadening instruction; video
17	Bottge et al. (2007)	v	v	v	v	v	v	v	v	v	v	v	v	anchored instruction; video
18	Ferretti et al. (2007)	v	v	v	v	v	v	v	v	v				project-based learning; video; TAM
19	Heo (2007)	v	v	v	v	v	v	v	v	v	v	v		anchored instruction

source of publication; (b) setting – scope of sampling (e.g., elementary, middle, and high school), and domain subject (e.g., math, history, and science); (c) subjects – participants' demographic characteristics (e.g., grade, sex, ethnicity, disability types) and number of participants in each subgroup; (d) methodology – research design (e.g., the independent–groups posttest design, the single group pretest–posttest design, and the independent groups pretest–posttest design); (e) treatment – specific components of a treatment (e.g., multimedia) and duration of treatment (e.g., number of session, and span of treatment); (f) dependent variable – outcome measures and level of knowledge transfer (e.g., knowledge acquisition, application and transfer); and (g) effect size – sample size and statistical values (e.g., mean score, standard deviation, t-statistics, and F-ratio).

As for the dependent variables, some studies reported outcome measures on both academic and non–academic achievement (e.g., social efficacy or motivation). Since the main interest of the study is students' knowledge transfer, however, only the academic performance measures in the studies were coded as dependent variables and classified according to the level of knowledge transfer (i.e., knowledge acquisition, application, and transfer).

Coding Reliability

To increase reliability in coding research, this study adopted several strategies recommended by Cooper and Hedges (1994) and Lipsey and Wilson (2001). First, a method of interrater reliability (IRR) was employed with three independent raters – One was the author of this study, who is a principle coder, and two were doctoral students in the field of special education. The interrater reliability indicates the extent to which different raters agree to put the same ratings to coded variables when they rate the same studies (Orwin, 1994). Often, the index of IRR is obtained by an agreement rate (AR), which divides the number of agreements by the total number of observations (i.e., agreement plus disagreement) and then multiplies by 100.

To make the data coding procedure more systematic, the author of this study created coding forms and a code manual. Coding forms consisted of 15 items that classify each study's characteristics (e.g., publication year, school, domain subject, grade, and use of multimedia).

To minimize errors in coding data, all items were designed to have one of these two types: (a) they may have numbers (e.g., publication year, sample size, etc.) that coders could easily and directly find from the articles or (b) they may have multiple choices that specify characteristics of a single study, which would help coders identify relevant information and select one proper choice about the corresponding study. The data were made as much of the original information as possible so coders can transcribe relevant numerical information directly from study to form. Also, a coding manual was developed with more detailed instructions so that coders could refer to at any time they had a question about an item in the coding forms. The coding manual and forms were provided in Appendix C and Appendix D, respectively.

Prior to data coding, coder training process took place in a group meeting to ensure that all of the coders properly used the coding manual and forms. In that meeting, given general and brief introduction, individual coders were invited to independently fill out the coding forms for one sample paper that is included in this study (i.e., Bottge et al.

2004) with the coding manual, and then, discussed the process and results together.

To produce a stable reliability estimate, more than 20 studies are desirable – with more than 50 being ideal – (Lipsey & Wilson, 2001). Consequently, this study checked all the studies' reliability (k = 19) on an item-by-item basis. Interrater reliability of the study was 92%.

Secondly, for trustworthiness with coding of dependent variables, each study's outcome measures and their constructs were assessed in detail on the basis of Haskell's (2001) model. Across 19 studies, a total of 58 outcome measures were reported related to students' academic achievement. To conduct meta-analysis, each of the outcomes was categorized into one of the three levels of knowledge transfer: (a) *level 1* – knowledge acquisition, (b) *level 2* – knowledge application, and (c) *level 3* – knowledge transfer. Then, two other independent raters, who are doctoral students in the field of special education, also rated them to classify each study's dependent variable. On eight outcome measures in six studies (i.e., Williams et al, 1994; Bottge et al., 2001; 2003; Ferretti, 2001; Fuchs et al., 2003b; 2006; MacArthur et al., 2002), there was a disagreement regarding classification among the three raters. Thus, further discussion occurred on those outcome measures until a clear consensus was reached.

Finally, since detailed documentation about coding rules and the rationales for each coding judgment can increase coding reliability (Orwin, 1994), such information was consistently saved and reported for the study. Especially for coding complex data to calculate effect sizes, the author took frequent breaks while inputting data to minimize errors resulting from fatigue, and saved the interim data so that the sources could partition the coding errors. In particular, initial data extracted from the original studies were recorded three different times using a spreadsheet program. Then, employing the program's "logical formulas; if – function," the author detected any inconsistencies in the data.

Stage 4: Analysis and Interpretation

Calculation of Effect Sizes

This study adopted Hedges' *g* with the bias correction to calculate each primary study's effect size. Compared to other formulas, such as Glass Δ or Cohen's *d*, Hedges' *g* is known to have less biased effect size estimation for small samples in single studies (Hedges & Olkin, 1985). Hedges' *g* with the unbiased estimate correction can be calculated using this formula:

$$\hat{\delta} = \left(1 - \frac{3}{4m - 1}\right) g \qquad (1)$$

where m is $N - 2$, N is the number of sample size, and g is Hedges' effect size representing the standardized mean differences between sample experimental group and control group divided by the square root of the pooled sample variance as follows:

$$g = \frac{\overline{X}_E - \overline{X}_C}{\sqrt{s_p^2}} \qquad (2)$$

where $\bar{X}$ is the mean, and the formula for the pooled sample variance (s_p^2) is:

$$s_p^2 = \frac{(df_E)s_E^2 + (df_C)s_C^2}{df_E + df_C} \qquad (3)$$

where df is $n - 1$, and s is the standard deviation

The sample variance, v_i, can be calculated as follows:

$$v_i = \hat{\sigma}^2_{\hat{\delta}_i} = \left[\frac{n_E + n_C}{n_E n_C}\right] + \left[\frac{\hat{\delta}^2}{2(n_E + n_C)}\right] \tag{4}$$

where n_E is the sample size in experimental group and n_C is that of control group.

If a study does not provide a mean or standard deviation score necessary for calculating effect size but only reports t-test or F-ratio, the scores can be transformed to Hedge's *g* with either of these formulas:

$$g = \frac{t\sqrt{n_E + n_C}}{\sqrt{n_E n_C}} \tag{5}$$

$$g = \frac{\sqrt{F(n_E + n_C)}}{\sqrt{n_E n_C}} \tag{6}$$

Once all of the effect sizes are obtained from the primary studies, the next step is to combine those estimates together to come up with one overall estimate of the population effect size ($\bar{\delta}$). To get a single best estimate of effect size, however, simply averaging all the effect sizes across studies is not enough because each study is based on a different sample size. Most often, a weighted average method is used on the premise that the effect sizes from the larger sample sizes have more precise values of the corresponding population estimate than those based on smaller sample sizes. Thus, more weight is given to effect sizes with larger sample sizes (Hedges & Olkin, 1985). The formula to calculate the weight, w_i, of an individual study *i* is:

$$w_i = \frac{1}{v_i} \tag{7}$$

where the conditional variance of each study, v_i, is in Equation (3). As is seen above, the larger the sample size, the smaller the variance, and the larger the weight.

Given this information, the pooled weighted average effect size across the studies can be calculated with the formula of the sum of weighted effect size per study divided by the sum of weights of the studies:

$$\overline{\delta_{\bullet}} = \frac{\sum_{i=1}^{k} w_i \hat{\delta}_i}{\sum_{i=1}^{k} w_i} \tag{8}$$

where w_i is the weight of an individual study, $\hat{\delta}_i$ is the effect size of each study i, and k represents the number of effect sizes.

The conditional variance associated with this pooled effect size is:

$$v_{\bullet} = \frac{1}{\sum_{i=1}^{k} \frac{1}{v_i}} \tag{9}$$

To calculate a confidence interval around the effect size estimate, the conditional variance can be used by taking the square root of this variance to obtain the standard error as follows:

$$\overline{\delta_{\bullet}} \pm C_{\alpha/2}\sqrt{v_{\bullet}} \tag{10}$$

The last step of calculating effect sizes is to calculate the ***Q***-statistic to test the homogeneity of effect sizes. Under the assumption of homogeneity of effect sizes (i.e., fixed-effects model), each study's effect size is sampled from a single true population effect size parameter, and the variability in effect sizes is due to sampling error. The formula to calculate ***Q***-statistic is:

$$Q = \sum_{i=1}^{k} \left[\frac{(\hat{\delta}_i - \bar{\delta}_\bullet)^2}{v_i} \right] \tag{11}$$

If the sample's ***Q***-statistic exceeds the χ^2 value in the chi-square distribution with $k - 1$ degrees of freedom, we can reject the null hypothesis (H_o), which means that the variance among the effect sizes is significantly greater than would be expected due to sampling error alone. Then, the variability in effect sizes can be re-examined using study characteristics.

For this study, I used the percentage of students with disabilities included in a general classroom as a predictor variable. To examine whether the disability composition of participants is negatively related to the effectiveness of situated learning, weighted least-squares regression analysis was conducted using the statistical package program SPSS, version 19.0. The relationship between the predictor variable (i.e., the composition of students with disabilities in inclusive classrooms) and each effect size (i.e., knowledge acquisition ($\bar{\delta}_{1\cdot}$), application ($\bar{\delta}_{2\cdot}$), and transfer ($\bar{\delta}_{3\bullet}$)) was separately investigated with a one-tailed t-test ($df = k - 1$) at the alpha level of .05.

Practical Issues in Meta-analysis

The process of calculating effect sizes from various primary studies and combining them to a pooled effect size estimate might be the most challenging part of conducting meta-analysis. Since individual studies have different research designs, experimental settings, and information on treatment results reported, meta-analysts should deliberate on how to deal with the diversity of study characteristics.

The first practical issue that the meta-analyst should take into account is to consider each primary study's research design. Mostly, an experimental study employs one of the following designs: (a) an independent–groups (IG) design to compare a treatment and a control group on treatment effects, (b) a single group repeated measures (RM) design to compare change scores between pre– and post–test of a group, and (c) an independent-groups, repeated measures (IGRM) design to compare a treatment and a control group on pre–post differences. If there found to be a group difference before implementing a treatment, data can be analyzed using analysis of covariance (ANCOVA), with pretest scores as the covariate. In this study, each primary study's research design was identified according to one of those four (i.e., IG, RM, IGRM and ANCOVA designs) and applied relevant formulas considering population standard deviations.

Secondly, the meta-analysis is required to consider dependencies in the data. For instance, some studies have multiple treatments and compare each treatment with a single control group; while some studies measure multiple outcomes with a single treatment. In either of the cases, the effect sizes might be dependent because the same control group is used for comparisons in multiple-treatment studies; and multiple measures can be related to each other in multiple-outcome studies. Therefore, the relevant correlations between the effect measures should be counted.

The covariance formula between the effects estimates for treatment *i* and *j* (δ_i and δ_j) for a multiple-treatment study is:

$$\mathrm{cov}(\delta_i\ \delta_j) = \frac{1}{n_c} + \frac{\delta_i \delta_j}{2N} \tag{12}$$

where $N = n_c + \sum_{j=1}^{J} n_j$ and J is the number of groups (j = 1, 2,… J)

The formula for multiple-outcome studies to obtain covariance between the effects estimates for outcome i and j (δ_i and δ_j) is:

$$\mathrm{cov}(\delta_i \delta_j) = \left[\frac{n_E + n_C}{n_E n_C} \right] \rho_{ij} + \left[\frac{\delta_i \delta_j \rho_{ij}^2}{2(n_E + n_C)} \right] \quad (13)$$

where ρ_{ij} = the correlation between outcome i and j

If the meta-analysis is interested in two or more effect measures, the covariance matrix ($\boldsymbol{\psi}$) that is associated with the multiple estimates of effect sizes needs to be constructed to take the relevant co-variances between each pair of outcomes into account. In this study, the outcome measures of all the primary studies were classified into three levels (i.e., knowledge acquisition (δ_1), (b) knowledge application (δ_2), and (c) knowledge transfer (δ_3)). Some of the studies (k = 10) had more than two outcome variables classified as the same level of knowledge transfer and some of the studies (k = 5) implemented more than two interventions related to situated learning. Given the multiple estimates of effect sizes, the relevant co-variances between each pair of the outcomes or treatments of the primary studies were calculated in the covariance matrix; and the inter-correlations among the effect sizes were also considered in the correlation matrix.

The final practical issue of the study was how to convert each study's findings into the same effect size metric. Since effect sizes extracted from different research designs estimate different population parameters, the effect size estimates cannot be compared directly or pooled together from studies using different experimental designs (Ray & Shadish, 1996). Thus, the meta-analyst should select one common metric that would be better fit to research questions and combine all effect sizes in the metric using diverse conversion formulas (Morris & DeShon, 2002).

For this study, the independent-groups (IG) metric was selected to combine effect sizes across experimental designs, because (a) the research questions of the study focus on the improvement of students' level of knowledge transfer as a result of situated learning compared to that of non treatment groups, (b) the majority of the selected articles used the independent-groups (IG) or independent-groups, repeated measures (IGRM) design comparing control and treatment groups (k = 13).

Thus, effect sizes obtained from repeated measures design studies were transformed into the common IG metric with this formula:

$$d_{IG} = d_{RM}\sqrt{2(1-\rho)} \tag{14}$$

where ρ is the correlation between pre- and posttest scores

In meta-analysis, sampling variance is in part a function of each primary study's research design as well as influenced by the sample size. Thus, different sampling error variance estimates was calculated with relevant formulas as follows:

For the single-group repeated measures design:

$$\left[\frac{2(1-\rho)}{n}\right]\left(\frac{n-1}{n-3}\right)\left[1+\frac{n}{2(1-\rho)}\delta_{IG}^2\right]-\frac{\delta_{IG}^2}{\left[c(n-1)\right]^2} \tag{15}$$

where $c(df) = 1 - \frac{3}{4df-1}$, $df = n - 1$

For the independent groups design:

$$\left(\frac{1}{\tilde{n}}\right)\left(\frac{N-2}{N-4}\right)(1+\tilde{n}\,\delta_{IG}^{2})-\frac{\delta_{IG}^{2}}{\left[c(N-2)\right]^{2}} \tag{16}$$

where $\tilde{n} = (n_E * n_C)/(n_E + n_C)$, and $c(df) = 1 - \frac{3}{4df-1}$, $df = n_E + n_C - 2$

CHAPTER 4: RESULTS

Data Evaluation

Study Characteristics

Study Settings

A total of 19 studies were synthesized in this meta-analysis. Table 5. provides overall characteristics for each primary study. All of the studies were published in peer-reviewed journals, except one dissertation (Heo, 2007). Publication dates ranged from 1994 to 2007. Most of the studies were published in the 2000s (k = 14), especially between 2000 and 2005 (k = 9), and five studies were published in the 1990s. The studies included in this analysis covered 3rd through 8th grades. Half of the studies were conducted in elementary schools (k = 10); the rest in middle schools (k = 9). No studies included students from kindergarten, 1st and 2nd grade students or high school students.

All interventions were implemented in general education classrooms as a form of collaborative learning among students with and without disabilities. The curricula content of situated learning included mathematics (k = 10), social studies (k = 5), science (k = 2), and reading/language arts (k = 2). Of the 19 studies, 11 studies (59%) used multimedia technology (e.g., video, computer) for situated learning. Treatment duration varied across the studies from 2 to 28 weeks and from 9 to 37 sessions. The average intervention treatment period was 10 weeks and 22 sessions.

To find the treatment effects on the students' performance, each study employed a different type of experimental design. The majority of the studies employed the

Table 5 *Study Characteristics*

ID	Study	School	Subject	Grade	Total N (SPED n)[b]	Study Design	Treat-ment	Outcome measures [c]	Level of transfer [d]
1	Williams [a] (1994)	Elementary	Reading	5th & 6th	68 (30)	IG	3 wks; 9 sess.	1-1 concept of theme 1-2 concept of perseverance 1-3 theme identification 1-4 theme application 1-5 story details 1-6 story components 1-7 theme identification 1-8 theme application	1-Acquisition 1-Acquisition 2-Application 2-Application 3-Transfer 3-Transfer 3-Transfer 3-Transfer
2	Okolo (1996)	Elementary	Social studies	4th	65 (22)	RM	8 wks; 25 sess	2-1 content knowledge	1-Acquisition
3	Dalton (1997)	Elementary	Science	4th	172 (33)	IG	6 wks; 12 sess	3-1 content knowledge 3-2 constructed diagram test	1-Acquisition 2-Application
4	Mastropieri (1998)	Elementary	Science	4th	75 (5)	IG/IGRM (ANCOVA)	7 wks; 21 sess	4-1 content knowledge 4-2 comprehension test 4-3 elaboration test	1-Acquisition 2-Application 2-Application
5	Bottge (1999)	Middle	Math	8th	17 (5)	IG/IGRM	2 wks; 10 sess	5-1 computation test 5-2 word problem test 5-3 contextualized test	1-Acquisition 2-Application 3-Transfer
6	Bottge (2001)	Middle	Math	8th	75 (19)	IG/IGRM (ANCOVA)	2 wks; 12 sess.	6-1 problem-solving test 6-2 WRAT-III; computation 6-3 maintenance test 1 6-4 maintenance test 2	2-Application 1-Acquisition 3-Transfer 3-Transfer

[a] The first author's last names were reported. [b](SPED n) is the number of students with disabilities receiving special education service. [c] Each study measures different learning outcomes as a result of situated learning. [d] Level of knowledge transfer is categorized into three: 1- knowledge acquisition, 2- knowledge application, and 3- knowledge transfer.

Table 5 (continued)

ID	Study	School	Subject	Grade	Total N (SPED n)	Study Design	Treat-ment	Outcome measures	Level of transfer
7	Ferretti (2001)	Elementary	Social studies	5th	87 (28)	RM	8 wks; 25 sess.	7-1 content knowledge 7-2 historical understanding 7-3 historical inquiry	1-Acquisition 2-Application 3-Transfer
8	Bottge (2002)	Middle	Math	7th	42 (8)	IG/IGRM (ANCOVA)	12 sess.	8-1 computation 8-2 text problem 8-3 contextualized problem 8-4 transfer	1-Acquisition 2-Application 3-Transfer 3-Transfer
9	MacArthur (2002)	Middle	Social studies	6th	31 (9)	RM	8 wks; 25 sess.	9-1 content knowledge 9-2 historical understanding	1-Acquisition 3-Transfer
10	Bottge (2003)	Middle	Math	8th	11 (5)	RM	24 sess.	10-1 probes	2-Application
11	Fuchs (2003a)	Elementary	Math	3rd	375 (30)	IGRM	16 wks.	11-1 immediate transfer 11-2 near transfer 11-3 far transfer	1-Acquisition 2-Application 3-Transfer
12	Fuchs (2003b)	Elementary	Math	3rd	395 (40)	IGRM	16 wks; 32 sess.	12-1 immediate transfer 12-2 near transfer 12-3 far transfer	1-Acquisition 2-Application 3-Transfer
13	Bottge (2004)	Middle	Math	6th	88 (17)	IG/IGRM (ANCOVA)	7 wks	13-1 computation test 13-2 word problem test 13-3 video problem 13-4 hovercraft problem	1-Acquisition 2-Application 3-Transfer 3-Transfer

Table 5 (continued)

ID	Study	School	Subject	Grade	Total N (SPED n)	Study Design	Treat-ment	Outcome measures	Level of transfer
14	Fuchs et al. (2004)	Elementary	Math	3rd	351 (29)	IGRM	16 wks; 34 sess.	14-1 Transfer 1 14-2 Transfer 2 14-3 Transfer 3 14-4 Transfer 4	1-Acquisition 2-Application 3-Transfer 3-Transfer
15	Gersten et al. (2006)	Middle	Social studies	7th & 8th	76 (36)	IG/IGRM (ANCOVA)	25 sess.	15-1 written exam 15-2 vocabulary matching	1-Acquisition 1-Acquisition
16	Fuchs et al. (2006)	Elementary	Math	3rd	445 (34)	IGRM	16 wks; 37 sess.	16-1 immediate transfer 16-2 near transfer 16-3 far transfer 1 16-4 far transfer 2 16-5 far transfer 3 16-6 far transfer 4	1-Acquisition 2-Application 3-Transfer 3-Transfer 3-Transfer 3-Transfer
17	Bottge et al. (2007)	Middle	Math	7th	22 (13)	RM	28 wks; 24 sess.	17-1 problem-solving 1 17-2 problem-solving 2	2-Application 3-Transfer
18	Ferretti et al. (2007)	Elementary	Social stu dies	5th	26 (8)	RM	8 wks.	18-1 content knowledge 18-2 historical inquiry	1-Acquisition 3-Transfer
19	Heo (2007)	Middle	Language arts	7th	80 (28)	IGRM	5 wks; 25 sess.	19-1 content knowledge	1-Acquisition

independent-groups design comparing control and treatment groups (k = 13). Of the 13 studies, 8 were the independent groups repeated measures (IGRM) design, 2 were the independent groups (IG) design, and 3 were both IGRM and IG designs. Six studies employed the single group repeated measures (RM) design. Consequently, more than half of the studies examined the effect of situated learning on students' academic improvements by comparing change scores (i.e., pretest to posttest) between the control and intervention group. Five studies implemented more than two interventions related to situated-learning in a study, and compared the treatment effects with a single control group (Bottge et al., 2001; Fuchs et al., 2003a; 2003b; 2004; 2006). The overall study settings are summarized in Table 6.

Table 6 *Study Settings*

Characteristic	Number of studies (%)	Characteristic	Number of studies (%)
Publication year		**Domain subject**	
1990 – 1995	1 (5%)	math	10 (53%)
1996 – 2000	4 (21%	social studies	5 (26%)
2001 – 2005	9 (47%)	reading/language arts	2 (11%)
2006 – 2011	5 (26%)	science	2 (11%)
School		**Instructional Technology**	
Elementary	10 (53%)	technology use	11 (58%)
Middle	9 (47%)		
		Research Design	
Grade		IG	2 (11%)
3rd – 4th grade	7 (37%)	IGRM	8 (42%)
5th – 6th	5 (26%)	IG/IGRM	3 (16%)
7th – 8th	7 (37%)	RM	6 (32%)

Note. The total number of studies, k = 19; IG= the independent groups design, IGRM = the independent groups, repeated measures design, RM = the single group, repeated measures design

Across 19 studies, a total of 81 outcomes were reported as treatment effects of situated learning on students' academic achievement. Of the 81 dependent measures, 23 (28%) outcomes were classified as knowledge acquisition (e.g., computation test in mathematics, and content knowledge test in social studies), 24 (30%) outcomes were classified as knowledge application (e.g., word problem solving test in mathematics, comprehension test in science, and theme identification test in language arts), and 34 (42%) outcomes were classified as knowledge transfer (e.g., contextualized test in mathematics, theme application test in language arts, and history reasoning/inquiry test in social studies).

In this meta-analysis, a total of 39 effect sizes were calculated from 81 outcome measures, because: (a) 35 outcomes from multiple treatments implemented in a study were combined into 16 effect sizes, (b) 16 multiple outcomes classified as the same level of knowledge transfer in a study were combined into 7 effect sizes, and (c) 14 outcomes were deleted due to insufficient information to calculate or combine effect sizes (e.g., F test on the group by time interaction, and the correlation coefficient between outcomes). Of the 39 effect sizes, 16 (41%) were for knowledge acquisition, 13 (33%) were for knowledge application, and 10 (26%) were for knowledge transfer.

Participant Settings

The nineteen studies included a total of 2,501 participants. On average 57% of the participants were male students. The majority of the participants were 3rd and 4th grade students (75%); followed by 5th and 6th grade students (12%) and 7th and 8th grade students (13%). Of the 13 studies (68%) that reported data on the ethnic background of the participants, 59% were Caucasian, 33% were African-American, 6% were Hispanic, 1% was Asian, and other minority groups occupied another 1%.

Of the total 2,501 participants, 16% were students with disabilities who received special education services (n = 399). Except for one, a total of 18 studies (95%) reported the types of disabilities among the students. The major disability of the participants was learning disabilities (83%), followed by multiple disabilities (5%), language disorders (4%), attention deficit and hyperactivity disorder (ADHD) (4%), behavior disorders (2%), and mild intellectual disabilities (2%). Table 7 provides the demographic data on the participants across 19 studies.

Table 7 *Student Demographic Data*

Characteristic	Percentage	Characteristic	Percentage
Participants		**Race** [a]	
All participants	100% (n=2501)	Caucasian/White	59%
		African -American	33%
Students with disabilities	16%	Hispanic	6%
	(n=399)	Asian	1%
		Other minority	1%
Gender			
Male	57%	**Disability types** [b]	
Female	43%	LD	83%
		EBD	2%
Grade		MR	2%
3rd -4th	75%	Language	4%
5th - 6th	12%	ADHD	4%
7th - 8th	13%	Multiple disabilities	5%
		Others	0%

Note. LD= learning disability; EBD=emotional and/or behavioral disabilities; MR=mental retardation; ID=intellectual disabilities; ADHD=attention deficit and hyperactivity disorder;
[a] 13 studies out of 19 provided data on participants' ethnic background. [b] 18 studies provided types of disabilities of students with special needs

Data Analysis

Calculating Effect Sizes from Primary Studies

To calculate effect sizes from each primary studies, Hedges' g with the unbiased estimate correction was used. The first step was to identify each study's research design according to the four different research designs (i.e., IG, RM, IGRM, and ANCOVA design). Since different experimental designs estimate different population parameters, relevant formulas considering population standard deviations were applied respectively. Of the 81 dependent measures, two effect sizes (i.e., study 7–3 and 9–1) could not be calculated because the studies did not provide the *F*-ratio on the group by time interaction necessary for calculating effect sizes for RM design studies.

In five studies, more than two interventions were implemented in a study: two interventions (k = 4) (Bottge et al., 2001; Fuchs et al., 2003b; 2004; 2006), and three interventions (k = 1) (Fuchs et al., 2003a). Since the multiple-treatments studies compared each of the treatment effects with a single control group, the relevant correlation between multiple treatments was considered by constructing covariance matrices with Formula 12 in Chapter 3. Consequently, 35 effect sizes from those 5 multiple-treatment studies were combined into 16 effect sizes.

In the same way, multiple outcomes classified as the same level of knowledge transfer (i.e., knowledge acquisition, application, and transfer) were combined so each study has one effect size per a level. A total of 16 dependent measures taken from 7 studies were combined into 7 effect sizes (Bottge et al., 2002; 2004; Fuchs et al., 2004; 2006; Gersten et al., 2006; Mastropieri et al., 1998; Williams et al., 1994). In particular, three of the studies measured multiple outcomes with multiple treatments (Bottge et al., 2001; Fuchs et al., 2004; 2006).

In all of the cases, the correlations between multiple outcomes were considered in calculating effect sizes by constructing covariance matrix with the formula in Equation (13). In particular, six outcome measures from two studies (Botge, 2001; Williams et al., 1994) could not be combined into two ultimate effect sizes due to insufficient information (i.e., the correlation coefficient between multiple outcomes and the standard deviation necessary for calculating variances).

Transforming Effect Sizes into a Common Metric

Before combining effect sizes across studies, all of the effect sizes obtained from primary studies were transformed into a common metric, independent groups (IG) design metric. According to Morris and DeShon (2002), this procedure requires that (a) effect sizes from each design estimate the same treatment effect, and (b) design–specific estimates of sampling variance be used for calculating effect size.

Thus, the potential sources of bias that may affect treatment effect was examined first, in terms of (a) the time effect – whether time affected both treatment and control group equally, and (b) the selection effect – whether the participants were randomly assigned to a group. It was assumed that there was no time effect in the studies, because each study implemented treatment(s) equivalently across groups. However, there was a selection effect for the studies employing the independent-groups design. Since all of the studies were conducted in school settings, students participating in a study could not be randomly assigned into experimental or control groups.

Next, effect sizes from 6 single group, repeated measures (RM) design studies (Bottge et al., 2003; 2007; Ferretti et al., 2001; 2007; MacArthur et al., 2002; Okolo et al., 1996) were converted to the IG metric using Formula 14 presented in Chapter 3. In addition, to convert all effect sizes across the 19 studies employing diverse research designs into the same IG metric, different design-specific estimates of sampling variance were applied based on the original study design (see Formula 15 and 16 in Chapter 3).

Combining Effect Sizes across Studies

Finally, a total of 39 effect sizes were calculated from the 19 studies. In combining effect sizes into three weighted average effect sizes ($\delta_1.$, $\delta_2.$, $\delta_3.$), two effect sizes from one study were excluded (Dalton et al., 1997) because it compared a situated intervention with another intervention (i.e., activities-based science). Since its treatment effect was not compared with a control group, the study's effect size could not be combined with the overall estimates of the population effect size in this study.

Moreover, the studies employing analysis of covariance (ANCOVA) were separately combined (Bottge et al., 2001; 2002; 2004, Mastropieri et al., 1998). Since the treatment effects of the studies were compared using adjusted means by setting pretest scores as covariate, the effect sizes were not comparable to that of other research design studies (i.e., IG, RM, and IGRM) (Morris & DeShon, 2002). Thus, the effect sizes from ANCOVA design studies were separately reported without combining them with other studies.

Data Interpretation

Effect Size for Knowledge Acquisition

The effect size estimates for knowledge acquisition (δ_1) were calculated across 15 studies; 95 percent confidence interval levels were also calculated to indicate the precision of the estimated effect sizes. The results were summarized in Table 8.

Table 8 *Effect Size Estimates for Knowledge Acquisition*

Knowledge Level	Study	Participants n_1	n_2	Effect size	95% CI[b] Lower	Upper	% of sped[c]
Level 1	Williams et al. (1994)	32	36	**1.737***	1.165	2.309	44.118
KAc[a]	Bottge (1999)	9	8	-0.297	-1.327	0.733	29.412
	Fuchs et al. (2003a)	95	280	**2.928***	2.613	3.243	8.000
	Fuchs et al. (2003b)	120	275	**5.434***	4.996	5.872	10.127
	Fuchs et al. (2004)	122	229	**6.941***	6.378	7.504	8.262
	Gersten et al. (2006)	38	38	**0.537***	0.073	1.001	47.368
	Fuchs et al. (2006)	144	301	**3.626***	3.314	3.938	7.640
	Heo (2007)	40	40	0.386	-0.062	0.834	35.000
	Okolo et al. (1996)	65	65	**0.340***	0.219	0.461	33.846
	Ferretti et al. (2001)	87	87	**0.507***	0.271	0.743	32.184
	Ferretti et al. (2007)	26	26	**0.359***	0.158	0.560	30.769
	Mastropieri et al. (1998)	50	25	**1.385***	0.846	1.924	6.667
	Bottge et al. (2002)	21	21	**0.965***	0.306	1.624	19.048
	Bottge et al. (2004)	42	40	**0.445***	0.001	0.889	20.732
	Gersten et al. (2006)	35	35	0.249	-0.229	0.727	51.429

Note. n_1 and n_2 are the sample sizes in the experimental and control group of the independent groups design, or the pre-test and post-test group of the repeated measures design; The author's name italicized represents studies using ANCOVA.
[a.] KAc is knowledge acquisition; [b.] CI = Confidence Interval; [c.] (sped) is the percentage of students with special needs included in a general education classroom

Across 15 studies, the effect size for knowledge acquisition ranged from –0.297 to 6.941. Except three studies (Bottge, 1999; Gersten et al., 2006; Heo, 2007), the effect of situated learning was significant on students' knowledge acquisition with a two-tailed test (α = .05), in the study of Williams et al. (1993) (δ_1 = 1.737, z = 5.953, p < .05), Fuchs et al. (2003a) (δ_1 = 2.928, z = 18.234, p < .05), Fuchs et al. (2003b) (δ_1 = 5.434, z = 24.308,

$p < .05$), Fuchs et al. (2004) ($\delta_1 = 6.941$, $z = 24.176$, $p < .05$), Gersten et al. (2006) ($\delta_1 = .537$, $z = 2.266$, $p < .05$), Fuchs et al. (2006) ($\delta_1 = 3.626$, $z = 22.804$, $p < .05$), Okolo et al. (1996) ($\delta_1 = 0.340$, $z = 5.502$, $p < .05$), Ferretti et al. (2001) ($\delta_1 = 0.507$, $z = 4.209$, $p < .05$), Ferretti et al. (2007) ($\delta_1 = 0.359$, $z = 3.495$, $p < .05$), Mastropieri et al. (1998) ($\delta_1 = 1.385$, $z = 5.039$, $p < .05$), Bottge et al. (2002) ($\delta_1 = 0.965$, $z = 2.869$, $p < .05$), and Bottge et al. (2004) ($\delta_1 = 0.445$, $z = 1.964$, $p < .05$).

The pooled weighted average effect size of the studies employing IG, RM or IGRM design ($k = 11$) were separately calculated from the studies using ANCOVA ($k = 4$). Under the assumption of homogeneity of effect sizes, the weighted average effect size for knowledge acquisition was 1.119 ($k = 11$), and the effect was significantly different from zero ($\delta_{1\bullet} = 1.119$, $z = 26.739$, $p < .05$); the pooled weighted average effect size from data using ANCOVA ($k = 4$) was 0.678 and also significant ($\delta_{1\bullet} = 0.678$, $z = 2.476$, $p < .05$).

Next, the Q-statistic was calculated to test whether the variability of the effect sizes are homogeneous and compared with a critical value, $\chi^2(10) = 18.307$ ($df = 10$, $\alpha = .05$) – In this study, the Q-statistic test was conducted only for the studies that did not use ANCOVA because there were a small number of studies using ANCOVA per each level of knowledge transfer (δ_1, δ_2, δ_3). The result of the chi-square homogeneity test indicated that there was substantial variance in the effect sizes ($Q = 1420.341$, $p < .05$). In other words, the variability of effect sizes could not be explained solely by sampling error. Thus, the effect sizes were re-analyzed with new estimates of study variances.

Under the assumption of heterogeneity of effect sizes, the pooled weighted average effect size of knowledge acquisition was 2.049, and the effect was significant at the alpha level of .05 ($\delta_{1\cdot}$ = 2.049, z = 2.835, $p < .05$), which indicates situated learning was effective on students' knowledge acquisition.

Lastly, to investigate whether the composition of students with disabilities included in general education classrooms affects the effectiveness of situated learning on knowledge acquisition, the relationship between the predictor variable (i.e., the percentage of students with special needs included in general education classrooms) and the effect sizes for knowledge acquisition was examined. A t-statistic was calculated and compared to the corresponding critical t-values of – 1.812 (df = 10, α = .05).

The result showed that the proportion of students with disabilities in a general education classroom significantly influenced the effectiveness of situated learning on knowledge acquisition [$t(10) = -32.317$, $p < .05$]. When it comes to the direction of the influence, it can be concluded that as the percent of students with disabilities increased, the effectiveness of situated learning for knowledge acquisition decreased.

Effect Size for Knowledge Application

Table 4.5 provides the effect size estimates for knowledge application (δ_2) across twelve studies with a 95% confidence interval level. The effect size for knowledge application from 12 studies ranged from –1.435 to 5.995. In nine out of twelve studies, situated learning was significantly effective on students' knowledge application with an alpha level of .05. These studies were Williams et al. (1993) (δ_2 = 1.111, z = 4.176, p < .05), Fuchs et al. (2003a) (δ_2 = 1.620, z = 12.167, p < .05), Fuchs et al. (2003b) (δ_2 =

2.984, z = 19.477, p < .05), Fuchs et al. (2004) (δ_2 = 5.995, z = 23.568, p < .05), Fuchs et al. (2006) (δ_2 = 2.924, z = 20.651, p < .05), Ferretti et al. (2001) (δ_2 = 0.467, z = 4.228,

Table 9 *Effect Size Estimates for Knowledge Application*

Knowledge Level	Study	Participants n_1	n_2	Effect size	95% CI[b] Lower	Upper	% of sped[c]
Level 2	Williams et al. (1994)	32	36	**1.111***	0.589	1.633	44.118
KAp[a]	Bottge (1999)	9	8	0.141	-0.884	1.166	29.412
	Fuchs et al. (2003a)	95	280	**1.620***	1.359	1.881	8.000
	Fuchs et al. (2003b)	120	275	**2.984***	2.684	3.284	10.127
	Fuchs et al. (2004)	122	229	**5.995***	5.496	6.494	8.262
	Fuchs et al. (2006)	144	301	**2.924***	2.646	3.202	7.640
	Ferretti et al. (2001)	47	48	**0.467***	0.251	0.683	60.870
	Bottge et al. (2003)	11	11	0.356	-0.222	0.934	45.455
	Bottge et al. (2007)	22	22	**0.818***	0.309	1.327	59.091
	Mastropieri et al. (1998)	50	25	**5.637***	4.579	6.695	6.667
	Bottge et al. (2002)	21	21	0.275	-0.349	0.899	19.048
	Bottge et al. (2004)	45	43	**-1.435***	-1.911	-0.959	19.318

Note. n_1 and n_2 are the sample sizes in the experimental and control group of the independent groups design, or the pre-test and post-test group of the repeated measures design; The author's name italicized represents studies using ANCOVA.
[a.] KAp is knowledge application; [b.] CI = Confidence Interval; [c.] (sped) is the percentage of students with special needs included in a general education classroom

p < .05), Bottge et al. (2007) (δ_2 = 0.818, z = 3.148, p < .05), Mastropieri et al. (1998) (δ_2 = 5.637, z = 10.444, p < .05), and Bottge et al. (2004) (δ_2 = –1.435, z = –5.903, p < .05).

Under the assumption of homogeneity of effect sizes, the estimate of weighted population effect size for knowledge application was 1.815 (k = 9), and the effect size was significantly different from zero with a two-tailed test and an alpha level of 0.05 (δ_2.

= 1.815, z = 30.995, p < .05); the two studies using ANCOVA produced the weighted average effect size of –0.074, but it was not significant ($\delta_{2\bullet}$ = –0.074, z = –0.190, p > .05).

Next, effect sizes were tested for homogeneity. The Q-statistic for this level of knowledge was 599.584 and exceeded the critical value of $\chi^2(8)$ = 15.507. That means, the effect size estimates need to be re-examined using new estimates of study variance because the variance among the effect sizes was considered as greater than expected by sampling error alone.

The pooled weighted average effect size under the assumption of heterogeneity of effect sizes was 1.836, and significantly different from zero ($\delta_{2\cdot}$ = 1.836, z = 2.927, p < .05), which shows situated learning was effective on students' knowledge application.

To examine whether the effect of situated learning on knowledge application was negatively related to the proportion of students with disabilities included in general education classrooms, a one-tailed t-test was conducted with the alpha level of .05 and compared to the critical t-values, t = – 1.860 (df = 8). The statistical inference showed that the higher the percentage of students with disabilities, the less effective the situated learning on knowledge application was [$t(8)$ = –17.815, p < .05].

Effect Size for Knowledge Transfer

Across 10 studies, effect size estimates for knowledge transfer (δ_3) were calculated and provided in Table 10 with a 95 percent confidence interval level. The effect size for knowledge transfer ranged from 0.595 to 3.725. In all studies, the effect of situated learning was significant on students' knowledge transfer, in the study of Bottge (1999) (δ_3 = 3.725, z = 3.969, p < .05), Fuchs et al. (2003a) (δ_3 = 1.045, z = 8.353, p <

.05), Fuchs et al. (2003b) (δ_3 = 0.884, z = 7.743, p < .05), Fuchs et al. (2004) (δ_3 = 2.147, z = 15.449, p < .05), Fuchs et al. (2006) (δ_3 = 0.886, z = 8.369, p < .05), MacAruthur et al. (2002) (δ_3 = 0.608, z = 3.177, p < .05), Bottge et al. (2007) (δ_3 = 0.595,

Table 10 *Effect Size Estimates for Knowledge Transfer*

Knowledge Level	Study	Participants n_1	n_2	Effect size	95% CI[b] Lower	Upper	% of sped[c]
Level 3	Bottge (1999)	9	8	**3.725***	1.886	5.564	29.412
KT[a]	Fuchs et al. (2003a)	95	280	**1.045***	0.800	1.290	8.000
	Fuchs et al. (2003b)	120	275	**0.884***	0.660	1.108	10.127
	Fuchs et al. (2004)	122	229	**2.147***	1.875	2.419	8.262
	Fuchs et al. (2006)	144	301	**0.886***	0.679	1.093	7.640
	MacArthur et al. (2002)	20	20	**0.608***	0.233	0.983	45.000
	Bottge et al. (2007)	17	17	**0.595***	0.069	1.121	76.471
	Ferretti et al. (2007)	18	18	**0.672***	0.258	1.086	44.444
	Bottge et al. (2002)	21	21	**1.982***	1.212	2.752	19.048
	Bottge et al. (2004)	20	23	**2.079***	1.304	2.854	39.535

Note. n_1 and n_2 are the sample sizes in the experimental and control group of the independent groups design, or the pre-test and post-test group of the repeated measures design; The author's name italicized represents studies using ANCOVA.
[a.] KT is knowledge transfer; [b.] CI = Confidence Interval; [c.] (sped) is the percentage of students with special needs included in a general education classroom

z = 2.216, p < .05), Ferretti et al. (2007) (δ_3 = 0.672, z = 3.182, p < .05), Bottge et al. (2002) (δ_3 = 1.982, z = 5.043, p < .05), and Bottge et al. (2004) (δ_3 = 2.079, z = 5.258, p < .05).

The pooled weighted effect size for knowledge transfer was 1.068 (k = 8) when the assumption of homogeneity of effect sizes was made, and the effect size was significantly different from zero (δ_3. = 1.068, z = 19.894, p < .05). The population weighted effect size of two ANCOVA studies was 2.030 and also significant ($\delta_3. = 2.030$, $z = 5.157$, $p < .05$).

The result of Q-statistic compared with a critical value, $\chi^2 = 14.067$ ($df = 7$, $\alpha = .05$) showed that there was substantial variance in the effect sizes ($Q = 87.249$, $p < .05$). Thus, the effect sizes were re-analyzed using new study variances. Under the assumption of heterogeneity of effect sizes, the weighted average effect size for knowledge transfer was 1.185, and significantly different from zero ($\delta_3. = 1.185$, $z = 3.122$, $p < .05$). From this we can infer that situated learning was effective on students' knowledge transfer.

Finally, a one-tailed t-test was conducted to examine the relationship between the proportions of students with disabilities included in general education classrooms and the effectiveness of situated learning on knowledge transfer. A t-statistic was calculated and compared to the critical t values of $-$ 1.895 ($df = 7$) at the level of $\alpha = .05$. The result shows that the composition of students with disabilities significantly influenced the effectiveness of situated learning on knowledge transfer [$t(7) = -3.523$, $p < .05$]. Therefore, it can be concluded that the impact of situated learning on knowledge transfer decreased when the percentage of students with disabilities was greater.

CHAPTER 5: DISCUSSION

This study employed a meta-analytic statistical method to investigate the effect of situated learning on the academic learning of students with and without disabilities in inclusive general education classrooms. First, the effect of situated learning was investigated according to three levels of knowledge transfer: (a) knowledge acquisition, (b) knowledge application, and (c) knowledge transfer. Second, the relationship between the effectiveness of situated learning and the composition of students with disabilities included in a general education classroom was examined. It was important to explore these research questions because the literature offers little useful information.

Discussions of the Findings

Study Characteristics

Study Settings

In this study, a total of 19 situated learning articles were selected among the studies published from 1980 to 2011. Most of the publications were concentrated in the years between 1996 and 2007 (k = 18). About half of the studies (k = 10) were conducted in elementary schools and the rest in middle schools. All the studies were conducted in elementary or middle schools, 3rd through 8th grades. None included kindergarten through 2nd grade or any high school students.

The limited research on these excluded groups reflects that the learner's age and corresponding ability may affect the implementation of situated learning. Situated learning is based on the socio constructivist theory. Although controversy exists regarding whether younger children can construct their own knowledge from active participations in social activities or collaborative learning (Bandura, 1986; Palincsar, 1998), this finding that none of the research was conducted with students under age 7 supports the notion that research regarding the effects of situated learning on younger children still needs to be conducted from the socio-constructivist perspective. On the contrary, as for the limited research conducted with older students, as indicated earlier in Chapter 3, situated learning interventions have been mainly implemented for selected groups, such as high school students without disabilities or with students in higher education for adult learning.

Participants

The 19 studies included a total of 2,501 students. The majority of the students were male (57%), 3rd or 4th grade students (75%), and Caucasian (59%). The students with special needs comprised 16% of the participants, while 83% were those with learning disabilities. Given that the purpose of this study was to examine the effect of situated learning in inclusive settings, it can be inferred that the group of students with special needs who receive most of their instruction in general education classrooms are those having high-incidence disabilities, including learning disabilities, mild intellectual disabilities, and behavioral disorders, or students having more than two disabilities.

Interventions and Outcomes

All of the interventions were implemented in general education classrooms in the areas of four subject domains (i.e., mathematics, science, reading and language arts, and social studies). Among those, the curricula contents that the situated learning was mostly conducted were mathematics (k = 10) and social studies (k = 5). Although previous research indicated that there have been surprisingly few studies implemented in the social studies area for students with disabilities (Curtis, 1991; De La Paz & MacArthur, 2003; Ferretti et al., 2001), it is interesting to note that a high percentage of studies of situated learning (26%) have been conducted in history.

The data implies that contextualized learning plays a large role in social studies instruction. Particularly, the recent research has shed light on the importance of historical understanding as well as knowledge of historical content with multiple perspectives (De la Paz & MacArthur, 2003; Ferretti et al., 2001; 2007; MacArthur et al., 2002; Wineburg, 1996). However, previous research indicated that students find it difficult to understand the people and events of the past; they tend to regard the past as much like the present (Ferretti et al., 2001; 2007, MacArthur et al., 2002). Thus, "contextualization" is regarded as an essential instructional element for developing historical understanding. Through contextualized learning, students are asked to interpret an event within cultural and spatial contexts by reflecting on historical situations in the social studies curriculum (Ferretti et al., 2001; 2007, MacArthur et al., 2002, Wineburg, 1996).

On the contrary, there were relatively few studies (k = 2) conducted in science class (Dalton et al., 1997; Mastropieri et al., 1998). According to Scruggs and Mastropieri (2007), research on science education for students with special needs has focused on, (a) science curriculum and learner characteristics, (b) mnemonic strategy instruction, (c) text structure analysis, (d) hands-on science curriculum, (e) coached elaborations, (f) discovery learning via inductive thinking, (g) correlates of successful inclusive science classes, and (h) class-wide peer tutoring with differentiated curriculum enhancements (Scruggs & Mastropieri, 2007). As for the situated learning studies, most dealing with science classes were implemented in non-inclusive classrooms. Therefore, it is necessary to examine the effect of situated learning on students' performance in inclusive science education classrooms.

The average treatment duration was 10 weeks and 22 sessions, but the treatment range varied across the 19 studies, from 2 to 28 weeks and from 9 to 37 sessions. About half of the studies (k = 11) used multimedia technology (e.g., video, computer) for situated learning. For example, a video anchor was used in social studies classes as a means for supplying background knowledge about a certain unit on a historical period (e.g., 19th century westward expansion) or for clarifying an event within its historical and cultural context (Ferretti et al., 2001; Gersten et al., 2006; Okolo et al., 1996).

Especially for the anchored instruction implemented in mathematics classes, a video anchor provided authentic contexts containing realistic problems and embedded data related to the solving of the problems (Bottge, 1999; Bottge et al., 2001; 2002; 2003; 2004; 2007). For instance, in "Bart's Pet Project," students were asked to think about whether two boys in the video could buy a pet and make an affordable cage for it. To solve this authentic problem, students were asked to apply their relevant knowledge of mathematics (e.g., adding and comparing whole numbers or decimals, computing with fractions and comparing them, and measuring inches) to the situation.

In terms of research design, a large number of studies compared a treatment effect between control and experimental groups (k = 13). Eight studies employed the independent groups repeated measures (IGRM) design, two were the independent groups (IG) design studies, and three studies employed both IG and IGRM designs. Accordingly, it was observed that more than half of the studies were designed to measure students' academic improvement by comparing change scores (i.e., pretest to posttest) between the control and intervention groups. Specifically, one study (Dalton et al., 1997) compared the situated learning with another treatment (i.e., activities-based instruction). Five studies implemented more than two interventions related to situated-learning.

The 19 primary studies yielded a total of 81 outcome measures related to students' academic performance as a result of situated learning. Across the studies, the greatest number of dependent measures (42%) were related to knowledge transfer (e.g., historical reasoning or inquiry test, and contextualized test in mathematics), followed (30%) by knowledge application (e.g., world problem-solving test, and theme identification test), and (28%) knowledge acquisition (e.g., computation of fractions or decimals in mathematics, and content knowledge test in social studies). Given that situated learning is interested in how to apply basic knowledge and skills to an authentic situation and to transfer them to a similar, but different situation, it is not surprising that the majority (72%) of study outcomes of situated learning were related to knowledge application and transfer.

Meta-Analysis (1): The Effects of Situated Learning

A total of 39 effect sizes were calculated from the 81 outcome measures. To obtain more precise and comparable effect size estimates, several decisions were made in combining effect sizes. First, when a single study included multiple treatments or multiple outcomes related to one of the three levels of knowledge transfer, the correlations between the outcomes were considered by constructing a covariate matrix. As a result, each study had one independent effect size per level of knowledge transfer. Second, effect sizes from diverse experimental designs were converted into one common metric, which is the independent groups (IG) design metric in this study. Then, all the effect sizes transformed into the same metric were combined for the weighted average effect size, using design-specific estimates of sampling variance to reflect the precision of the effect size estimates.

Third, when a study compared situated instruction with another intervention without a control group, the study's effect sizes were not pooled to the weighted average effect size in this meta-analysis. Similarly, as for the studies comparing the treatment effects using adjusted means through an analysis of covariance (ANCOVA), neither were their effect sizes combined with the overall population effect sizes, but, in this study, reported separately. In such cases, the effect sizes are not comparable with those of the rest of the studies drawn from the standardized mean differences between control and experimental groups. Taking those principles into account, this study produced three weighted average effect sizes from 28 effect sizes, which are the weighted overall mean effect sizes for knowledge acquisition (n = 11), knowledge application (n = 9), and knowledge transfer (n = 8) (see Table 8, 9, and 10 in Chapter 4). The analyses of the results are summarized in Table 11.

Level 1 – Knowledge Acquisition

This meta-analytic approach shows that the situated learning produced a positive and statistically significant effect on students' knowledge acquisition ($\delta_{1\cdot}$ = 2.049, z = 2.835, p < .05). Cohen (1988) classified an effect size of .30 as a small effect, around .50 as a medium effect, and more than .80 as a large effect. In light of such a classification, this weighted average effect size of knowledge acquisition (2.049) was quite large. In other words, the statistical inference indicated that, after students are engaged in situated learning, the average performance of the students was about 2.049 standard deviations above the average performance of students without the intervention.

On the basis of 15 studies, the effect sizes varied greatly, ranging from –0.297 to 6.941. In twelve out of the fifteen studies (80%), the treatment effects were statistically

Table 11 *Effect Sizes for the Three Levels of Knowledge Transfer*

Levels of knowledge transfer	Range [a]	RE effect size [b]	Significance [c]	Relationship with sped % [d]
Knowledge Acquisition	–0.297 ~ 6.941	2.049	(z = 2.835, p< .05)	t(10) = –32.317
Knowledge Application	–1.435 ~ 5.995	1.836	(z = 2.927, p < .05)	t(8) = –17.815
Knowledge Transfer	0.595 ~ 3.725	1.185	(z = 3.122, p < .05)	t(7) = –3.523

[a] The range was based on different number of studies: Knowledge acquisition (n=15), application (n=12), transfer (n=10). [b] The weighted average effect sizes were calculated from knowledge acquisition (n=11), application (n = 9), transfer (n = 8) [c] two-tailed test with the alpha level of .05. [d] sped%: the percentage of students with disabilities included in general education classrooms.

significant at the alpha level of .05 and also were positive favoring situated learning. Originally, two of the 19 primary studies reported negative effects on students' knowledge acquisition from situated learning (i.e., Bottge, 1999 and Bottge et al., 2001). These results, however, were not statistically significant. Those studies were conducted in 8th grade middle school classrooms in mathematics classes by the same first author.

In the studies, while students who received situated instructions outperformed those in the control group on problem solving tests, for mathematics computation tests (i.e., computing fractions, decimals, times, speeds, and distance), the scores of the students in the treatment groups deteriorated from pretest to posttest. The authors attributed the decline to a relatively short intervention period for teaching basic knowledge and skills (Bottge et al., 2001). Consequently, the study highlighted the importance of creating a balance between exploring basic concepts and engaging students in problem solving.

Level 2 – Knowledge Application

The weighted mean effect size for knowledge application, in terms of Cohen's (1988) conventional criteria, was also large (1.836) as well as statistically significant in 95% of the confidence interval level ($\delta_{2\cdot} = 1.836$, $z = 2.927$, $p < .05$). The result indicated that, under the assumption of normal distribution of populations with equal variance, the average performance of the students who received situated learning was higher than 96.71% of the performance of those in the control group.

Across the 12 studies, the range of effect sizes for knowledge application varied to a great extent, from –1.435 to 5.995. In particular, there was one negative effect size (i.e., Bottge et al., 2004), which is statistically significant ($\delta_2 = -1.435$, z = –5.903, p < .05). The study was conducted in a mathematics class with 6th grade middle school students, and the outcome measure assessing students' knowledge application was an 18-item word problem test. The reason why the students in the control groups outperformed those who received a situated learning on word-based problem solving test was attributed, by the authors, to the close alignment of the testing format with the nature of the traditional interventions. In other words, students who received text-based instruction in the control group could earn higher scores on a word-based problem solving test because that measure was more closely aligned with the curriculum (Bottge et al., 2004).

Except for the one study yielding a significant negative effect size, 75% of the studies (k = 9) produced statistically significant and positive effect sizes for knowledge application using a two-tailed test at the alpha level of .05. Taking into account the overall results and the large weighted mean effect size ($\delta_{2.} = 1.836$), this study provides evidence for the effectiveness of situated learning on the learning of students' knowledge application.

Level 3 – Knowledge Transfer

The result of the meta-analytic review on knowledge transfer was consistent with that of knowledge acquisition and application. The overall weighted average effect size for knowledge transfer was large and statistically significant favoring situated instruction ($\delta_{3.} = 1.185$, $z = 3.122$, $p < .05$). That is, the score of the average student who received situated learning was higher than 88.30 % of the scores of those who were not given the intervention.

None of the 10 studies reported a negative effect size for knowledge transfer. All of the positive effect sizes were statistically significant at the alpha level of .05. In addition, the range of the effect sizes was relatively narrow, from 0.595 to 3.725, compared to that of the knowledge acquisition and application.

Consequently, the result of this meta-analysis revealed that, on all of the levels of knowledge transfer (i.e., knowledge acquisition, application, transfer), situated learning is effective for the learning of students with and without disabilities in inclusive general education classrooms. Under the assumption of heterogeneity of effect sizes in random effects model, all of the weighted average effect sizes were statistically significant at the alpha level of .05 and also positive favoring the treatment group on knowledge acquisition ($\delta_{1}.$ = 2.049, z = 2.835, $p < .05$), on knowledge application ($\delta_{2}.$ = 1.836, z = 2.927, $p < .05$), and on knowledge transfer ($\delta_{3}.$ = 1.185, z = 3.122, $p < .05$).

In terms of the magnitude of effect sizes, those weighted overall effect sizes were all considerably large (see Cohen, 1988), which indicates that the average score of the students who received situated learning was greater than 97.98% of the scores of those who were in the control group on knowledge acquisition, 96.71% of the scores on knowledge application, and 88.30% of the scores on knowledge transfer.

Previous research on situated learning reported its effects differently according to the students' knowledge acquisition, application, and transfer (see Bottge, 1999; Bottge et al., 2002; 2004, Ferretti et al., 2001; Mastropieri et al., 1998; Williams et al., 1994). However, this meta-analytic review provides evidence for the effectiveness of situated learning across all three levels of knowledge transfer: Knowledge acquisition, application, and transfer.

These results are notable because, although the main interest of situated learning is how to transfer the basic knowledge and skills to an authentic context or novel situation, its effectiveness was also largest on students' knowledge acquisition of basic knowledge and skills, such as computing fractions, time, and speed in mathematics or learning declarative content knowledge in social studies. Bottge and his colleagues (2001) indicated that, "situated cognition and cognitive apprenticeship suggest that students gain deeper understandings of curriculum when they actively construct knowledge in contexts that they find meaningful and motivating" (p. 299). Along the same line, the students' overall improvement of academic performance in all levels of knowledge transfer can be attributed in part to their sustained interest in learning through participating in purposeful and meaningful activities with peers in the classrooms, as the previous observational research has revealed (see. Bottge et al., 2001; Ferretti et al., 2001; Okolo et al., 1996).

More interestingly, situated learning produced the largest effect size on students' knowledge acquisition ($\delta_{1.}$ = 2.049), followed by knowledge application ($\delta_{2.}$ = 1.836), and knowledge transfer ($\delta_{3.}$ = 1.185). Since each of the effect sizes was independently calculated and the different number of studies was included respectively, the results could not be compared directly with one another. However, the pattern of results, which is the larger effect sizes (in order of magnitude, knowledge acquisition, knowledge application and knowledge transfer), provides evidence for the importance of prerequisite knowledge in the student's learning.

A lot of research has indicated that, knowledge acquisition of basic concepts and skills is a prerequisite for a higher level of knowledge transfer, (Bandura, 2000; Bransford et al., 1999; Cooper & Sweller, 1987; Ferretti et al., 2001; Fuchs et al., 2003a; Schunk, 1999; Sugrue, 1995). For example, Cooper and Sweller (1987) found that, in order to solve novel problems, students must (a) master basic rules for problem solving,

(b) develop categories for organizing problems into groups requiring similar solutions, and (c) be aware of relevance between the novel problem and previously acquired knowledge.

Similarly, Sugrue (1995) identified the key ingredients for successful problem solving as (a) understanding of basic concepts, (b) developing the principles that link concepts, and (c) linking from the principles and concepts to conditions and procedures for application. Thus, the findings of this study are generally consistent with previous research documenting the importance of prerequisite knowledge acquisition in applying or transferring knowledge to a given situation.

In other contexts, however, several researchers have raised the question of whether the assessment measure may affect the students' scores (Fuchs et al., 2004; Ferretti et al,. 2007; Gijbels et al., 2005). Specifically, Ferretti and his colleagues (2007) reported some contrasting results among the studies examining the effect of project-based learning on students' content knowledge acquisition. They indicated that the difference may be attributed to a small sample size and different assessment methods between narrative frameworks (e.g., Ferretti et al., 2001; 2007) and multiple-choice (e.g., Ferretti & Okolo, 1997; Okolo & Ferretti, 1996).

Also, Fuchs and her colleagues (2003) indicated that students' higher achievements on the tests assessing the nearer transfer (i.e., knowledge acquisition and application) than on tests assessing far transfer (i.e., knowledge transfer) could be attributed to the degrees of alignment of the measurement with the nature of the interventions: "On the immediate-transfer measure, which was aligned closely with the solution treatment, either the solution treatment or the instructional format may explain the statistically significantly and substantially superior improvement of all three experimental groups over the control group" (p. 299).

Therefore, the effect of assessment types on students' achievement needs to be separately examined. More specifically, it is necessary to examine whether different formats of assessment method (e.g., multiple-choice, narrative frameworks, word-based problem-solving) yield different treatment effects on the same level of knowledge transfer. It can be also meaningful to investigate whether students gain higher scores on a certain type of measurement, if it is used during an intervention as a formative assessment. Such studies are essential to reveal whether students' achievements result from the type of assessment or treatment effect they participate in.

Meta-Analysis (2): Relationship with the Composition of Students with Disabilities

The purpose of the second meta-analytic review was to examine whether the composition of students with disabilities included in regular classrooms is related to the effectiveness of situated learning. To meet this purpose, the study adopted the percentage of students with disabilities in inclusive settings as a predictor variable and conducted *t*-test according to the three levels of knowledge transfer. As indicated earlier, 399 of the 2,501 participants (16%) were students with disabilities. And 83% of these were classified as having learning disabilities ($k = 18$). The range of the percentage of students with special needs varied widely from 6.667% (i.e., Mastropieri et al., 1998) to 76.471% (i.e., Bottge et al., 2007).

Overall, the percentage of students with special needs in general education classrooms had a negative and significant influence on the effectiveness of situated learning. That is, as more students with special needs were included, the treatment effect decreased for knowledge acquisition [$t(10) = -32.317$, $p < .05$], for knowledge application [$t(8) = -17.815$, $p < .05$], and for knowledge transfer [$t(7) = -3.523$, $p < .05$].

The findings were predictable based on low achievement of students with disabilities in general education classrooms. Most importantly, however, the pattern of results, which *t*-test statistics tended to decrease as the level of knowledge transfer increased from knowledge acquisition [i.e., $t(10) = -32.317$], knowledge application [$t(8) = -17.815$] to knowledge transfer [i.e., $t(7) = -3.523$]. The findings imply that the proportion of students with special needs in general education classrooms does not influence as greatly the learning of knowledge transfer as it does knowledge acquisition.

In fact, interesting results were reported from several primary studies analyzing the outcomes of students with disabilities separately from their peers without disabilities. Especially concerning knowledge transfer, the improvement of students with disabilities was comparable to that of students without disabilities (i.e., Ferretti et al., 2001and Fuchs et al., 2003b) or even larger (i.e., Bottge et al., 2001; 2007 and MacArthur et al., 2002). For example, one of teachers who participated in a study of situated learning mentioned the unexpected outstanding performance of low-achieving students on knowledge transfer such that,

> the people who won [the car pentathlon competition event] are normally people who are not successful in math. The people in my classes – first, second, and third – were people who never got the highest grades and had more difficulties, even

the kids in my algebra class. The girl who won it normally comes on a daily basis and has a lot wrong on her homework. (Bottge et al., 2007; p. 47)

Similarly, an observational study of multimedia-based anchored instruction (Bottge et al., 2001) revealed that low-achieving students in remedial math classrooms who seemed to use math as a "tool" produced better outcomes than those students who just tried following the "procedures" that had been shown in the video, rather than remembering the formula to calculate one single answer.

In such cases, researchers must still answer the question of why the students with disabilities performed fairly well or even better on knowledge transfer than those without disabilities. Knowledge transfer has been regarded as a more difficult goal to achieve for low-achieving students. It is noteworthy then that in situated learning the percentage of students with disabilities in general education classrooms affected knowledge transfer less than knowledge acquisition. Therefore, as Ceci and Roazzi (1994) mentioned, "we cannot conclude that children lack certain cognitive abilities just because they do not exhibit them in a given context" (p. 93), a more cautious inference should be made for the learning of higher-level of knowledge to the students with disabilities who receive most of their instruction in general education classrooms.

These findings also support the notion that teachers need to pay more attention to knowledge transfer of students with disabilities. In general, most of the instructions for students with disabilities focused on knowledge acquisition of basic concepts and skills rather than knowledge transfer. Teachers tend to assume that, because they lack basic knowledge and skills—prerequisites for higher level of learning—students with disabilities may not be ready to learn how to transfer knowledge into an authentic context or other similar situations. Such assumptions lead teachers to focus excessively on basic concepts and skills in their teaching of students with disabilities in the classroom.

Regarding the learning of higher-order skills in reading instruction for students with disabilities, Wilder and Williams (2001) raised a similar issue:

> This focus not only limits the amount of instruction devoted to comprehension [higher order skills], but it also may lead to a view of reading as accurate word recognition rather than as a source of information about the world and as a basis for critical thinking. In addition, during the limited time allotted to comprehension instruction for these students, teachers tend to ask simple factual questions that do not require reasoning, thus limiting further the opportunities to acquire higher order skills (p. 268).

Therefore, teachers need to strike a balance between providing opportunities to students with disabilities to learn basic knowledge and skills in contextualized learning environments and transferring them into meaningful, authentic situations.

Limitations of the Study

Findings from this meta-analysis need to be cautiously interpreted due to some limitations of the study. The first and most important concern is the relatively small number of studies (k = 19) included in this study. As discussed earlier, many situated-learning studies have been conducted at the college level or with high school students without disabilities or instruction was implemented in non-inclusive settings where students with and without disabilities were taught separately.

The 19 primary studies reported a total of 81 outcome measures related to students' academic performance. From the 81 outcomes, 37 effect sizes were calculated, and then divided into three levels of knowledge transfer: 15 effect sizes for knowledge acquisition, 12 for knowledge application, and 10 for knowledge transfer. Next, the final weighted average effect sizes per level of knowledge transfer were calculated from a total of 28 effect sizes. This was because, in this study, the effect sizes of ANCOVA studies were reported separately. Those steps resulted in being able to include only 11 effect sizes for knowledge acquisition, 9 for knowledge application, and 8 for knowledge transfer. Although the limited number of effect sizes did not provide enough statistical power, this study included a predictor variable to examine the second research question (i.e., the relationship between the effectiveness of situated learning and the composition of students with disabilities included in general education classrooms). Therefore, cautions must be exercised in not only interpreting the results but also generalizing this study's findings.

Second, several multiple-treatments or multiple-outcomes studies reported insufficient statistical information to combine effect sizes (e.g., the correlation coefficients between outcomes, the test-retest reliability, standard deviations in multiple-treatment ANCOVA studies etc.). In such cases, other study's estimates of the relevant correlation were substituted for those of studies lacking correlations between outcome measures. However, this was not always the case. More efforts were made to contact authors of the original studies to obtain the data needed to calculate effect sizes. Such effort, however, was mostly unsuccessful. Thus, this study could not include all the effect sizes calculated from the primary studies into a pooling of the weighted average effect sizes.

Third, as is the most frequently discussed issue with meta-analyses, this study is subject to a publication bias. That means, when a meta-analysis is conducted with only published articles, its results might reach biased findings to positive effects because published articles are more likely to report only statistically significant results. In fact, this study included unpublished studies by searching for dissertations and theses using ProQuest databases. Yet except for one dissertation, all were articles published in peer-reviewed journals.

Lastly, the conceptual framework used for classifying each study's outcomes into one of the three levels of knowledge transfer (i.e., knowledge acquisition, application, transfer) was influenced by three raters, all of whom were doctoral students in the field of special education.

Implications for Future Research

In sum, this meta-analytic study revealed that, on all of the levels of knowledge transfer (i.e., knowledge acquisition, application, application), the situated learning is effective for the learning of students with and without disabilities in inclusive general education classrooms. All of the weighted mean effect sizes were statistically significant favoring situated instruction, and produced large effect sizes for knowledge acquisition ($\delta_{1\cdot}$ = 2.049), for knowledge application ($\delta_{2\cdot}$ = 1.836), and for knowledge transfer ($\delta_{3\cdot}$ = 1.185). Although the proportion of students with disabilities included in general education classrooms had a negative influence on the effectiveness of situated learning, the pattern of results showed that the percentage of students with special needs did not affect the learning of knowledge transfer as much as it did the knowledge application or knowledge acquisition.

The findings from this meta-analytic review provide important insight into the overall effect of situated learning on the learning of students with and without disabilities who are taught together in inclusive general education classrooms. First, situated learning produces strong and positive effects on all levels of knowledge transfer—knowledge acquisition, application, and transfer. In a relative comparison, situated learning yields the largest effect size on students' knowledge acquisition, followed by knowledge application, and knowledge transfer.

In addition, the proportion of students with special needs in inclusive settings yields a negative and significant influence on the effectiveness of situated learning. However, it is noteworthy that the percentage of students with disabilities does not influence as greatly the learning of knowledge transfer as it does knowledge acquisition; the significant negative impacts decrease as the level of knowledge transfer increases from knowledge acquisition, knowledge application to knowledge transfer.

These findings suggest several areas for further research: First, a meta-analysis is needed that examines whether the effect of situated learning is mediated by other variables such as age, gender, subject matter, or use of technology. To secure enough statistical power though, a larger number of studies should be included.

Second, more research on situated learning should be conducted for younger students from Kindergarten to 2nd grade, and in high school general education classrooms where students with and without disabilities are taught together. The effect of situated learning also needs to be examined in diverse curriculum domains, such as science and language arts.

Third, the relationship between assessment types and students' achievement needs to be investigated. As previous research indicated (i.e., Ferretti et al., 2007; Fuchs et al., 2010), the form of measurement (e.g., narrative format and multiple-choices) or how closely the test aligns with the nature of the interventions (e.g., word-based problem solving test and textbook-based instruction) could affect students' academic performance in terms of the level of knowledge transfer.

Finally, a more in-depth examination should be made for the effect of situated learning on knowledge transfer of students with disabilities in inclusive settings. As noted earlier, several studies reported that the improvement of students with disabilities on knowledge transfer was even greater than that of those without disabilities (i.e., Bottge et al., 2001; 2007 and MacArthur et al., 2002). Thus, further study should investigate how, in inclusive general education classrooms, situated learning helps students with disabilities to transfer knowledge.

APPENDIX A

Articles for Research Synthesis – Anchored Instruction

Bottge, B.A., & Hesselbring, T.S. (1993). A comparison of two approaches for teaching complex, authentic mathematics problems to adolescents in remedial math classes. *Exceptional Children, 59*, 556-566.

Bottge, B. A., Heinrichs, M., Chan, S., & Serlin, R. C. (2001). Anchoring adolescents' understanding of math concepts in rich problem-solving environments. *Remedial and Special Education, 22*(5), 299-314.

Bottge, B. A., Heinrichs, M., Mehta, Z. D., & Hung, Y. H. (2002). Weighing the benefits of anchored math instruction for students with disabilities in general education classes. *Journal of Special Education, 35*(4), 186-200.

Bottge, B. A., Heinrichs, M., Chan, S. Y., & Mehta, Z. D. (2003). Effects of video-based and applied problems on the procedural math skills of average- and low-achieving adolescents. *Journal of Special Education Technology, 18*(2), 5-22.

Bottge, B. A., Heinrichs, M., Mehta, Z. D., Rueda, E., Hung, Y., & Danneker, J. (2004). Teaching mathematical problem solving to middle school students in math, technology education, and special education classrooms. *Research in Middle Level Education Online, 27*(1), 43-68.

Bottge, B.A, Rueda, E., Serlin, R.C., Hung, S.Y-H, & Kwon, J.M. (2007). Shrinking achievement differences with anchored math problems: Challenges and possibilities. *The Journal of Special Education, 41*(1), 31-49.

Glaser, C. W., Rieth, H. J., Kinzer, C. K., Colburn, L. K., & Peter, J. (1999). A description of the impact of multimedia anchored instruction on classroom interactions. *Journal of Special Education Technology, 14*(2), 27-43

Rieth, H. J., Bryant, D. P., Kinzer, C. K., Colburn, L. K., Hur, S., Hartman, P., & Choi, H. (2003). An analysis of the impact of anchored instruction on teaching and learning activities in two ninth-grade language arts classes. *Remedial and Special Education, 24*(3), 173-184.

APPENDIX B

Articles for Meta-analysis

Bottge, B.A.(1999). Effects of contextualized math instruction on problem solving of average and below average achieving students, *Journal of Special Education, 33*(2), 81-92.

Bottge, B. A., Heinrichs, M., Chan, S. Y., & Mehta, Z. D. (2003). Effects of video-based and applied problems on the procedural math skills of average- and low-achieving adolescents. *Journal of Special Education Technology, 18*(2), 5-22.

Bottge, B.A., Heinrichs, M., Chan,S., & Serlin, R.C. (2001). Anchoring adolescents' understanding of math concepts in rich problem-solving environments, *Remedial and Special Education, 22*(5), 299-314.

Bottge, B. A., Heinrichs, M., Mehta, Z. D., & Hung, Y. H. (2002). Weighing the benefits of anchored math instruction for students with disabilities in general education classes. *Journal of Special Education, 35*(4), 186-200.

Bottge, B. A., Heinrichs, M., Mehta, Z. D., Rueda, E., Hung, Y., & Danneker, J. (2004). Teaching mathematical problem solving to middle school students in math, technology education, and special education classrooms. *Research in Middle Level Education Online, 27*(1), 43-68.

Bottge, B.A, Rueda, E., Serlin, R.C., Hung, S.Y-H, & Kwon, J.M. (2007). Shrinking achievement differences with anchored math problems: Challenges and possibilities. *The Journal of Special Education, 41*(1), 31-49.

Dalton, B., Morocco, C.C., Tivnan, T., & Mead, P.L.R (1997). Supported inquiry science:

teaching for conceptual change in urban and suburban science classrooms, *Journal of Learning Disabilities, 30*(6), 670-684.

Ferretti, R.P., MacArthur, C.D., Okolo, C.M. (2001). Teaching for historical understanding in inclusive classrooms, *Learning Disability Quarterly, 24*(1), 59-71.

Ferretti, R.P., MacArthur, C.A., & Okolo, C.M. (2007). Students' misconceptions about U.S. Westward migration, *Journal of Learning Disabilities, 40*(2), 145-153.

Fuchs, L.S., Fuchs, D., Finelli, R., Courey, S.J., & Hamlett, C.L. (2004). Expanding schema-based transfer instruction to help third graders solve real-life mathematical problems*, American Educational Research Journal, 41*(2), 419–445.

Fuchs,L.S., Fuchs,D., Finelli,R., Courey,S.J., Hamlett,C.L., Sones,E.M., & Hope,S.K. (2006). Teaching third graders about real-life mathematical problem solving: A randomized controlled study. *The Elementary School Journal, 106*(4), 293-311.

Fuchs, L.S., Fuchs, D., Prentice, K.,Burch, M., Hamlett, C.L., Owen, R., Hosp, M., & Gancek, D. (2003a). Explicitly teaching for transfer: effects on third-grade students' mathematical problem solving. *Journal of Educational Psychology, 95*(2), 293-305.

Fuchs, L.S.; Fuchs, D.; Prentice, K., Burch, M., Hamlett, C., Owen, R., & Schroeter, K. (2003b). Enhancing third-grade student' mathematical problem solving with self-regulated learning strategies. *Journal of Educational Psychology, 95*(2), 306-315.

Gersten, R., Baker, S.K., Smith-Johnson, J., Dimino, J., & Peterson, A. (2006). Eyes on the prize: teaching complex historical content to middle school students with learning disabilities. *Exceptional Children, 72*(3), 264-280.

Heo,Y. (2007). The impact of multimedia anchored instruction on the motivation to learn of students with and without learning disabilities placed in inclusive middle school language arts classes. *Dissertation Abstracts International, 68*(12). (UMI No.3290930).

MacArthur, C.A., Ferretti, R.P. & Okolo, C.M. (2002). On defending controversial viewpoints: Debates of sixth graders about the desirability of early 20th-centry American immigration, *Learning Disabilities Research & Practice, 17*(3), 160-172.

Mastropieri,M.A., Scruggs, T.E., Mantzicopoulos, P., Sturgeon,A., Goodwin, L., & Chung, S. (1998). A place where living things affect and depend on each other: Qualitative and quantitative outcomes associated with inclusive science teaching, *Science & Education, 82*, 163-179.

Okolo C., & Ferretti, R. P (1996). The impact of multimedia design projects on the knowledge, attitudes, and collaboration of students in inclusive classrooms, *Journal of Computing in Childhood Education, 7,* 223-251.

Williams, J.P., Brown, L.G., Silverstein, A.K., & deCani, J.S (1994). An instructional program in comprehension of narrative themes for adolescents with learning disabilities, *Learning Disability Quarterly, 17,* 205-221.

APPENDIX C

Coding Manual

Write your name on page 1. When you finish coding, record the approximate total time it took you to complete coding and rate your level of confidence on your work in a scale of 1 to 5 (1: low, 5: high).

<u>Bibliographic Reference</u>

1. **Study ID Number**: A study ID number was assigned to each study. You can find the ID number on the top of the front page of each article. If an article presents two independent studies (i.e., two independent outcome studies with different participants such as being conducted in Class 1 and Class 2), a decimal number is added to the study ID number (e.g., 8-1, 8-2).
2. **Type of Publication**: Choose the publication type of the study. You should record the corresponding number with it.
3. **Publication Year**: Record the four-digit publication year (e.g., 1994).

<u>Sample Descriptors</u>

4. **School**: Select the school level. If a study was implemented to schools across two levels, you should consider #4 and #5. For example, if 5^{th} grade and 6^{th} grade students participated in a study, the most appropriate choice would be #4, Elementary & Middle.
5. **Domain Subject**: Choose the Domain Subject. If there is no example on the coding form, type in #6 and specify the subject (e.g., Music).
6. **Grade**: Record the participants' grade. If there are more than two, type in the grades respectively (e.g., 5^{th} and 6^{th}).
7. **Mean Age (yrs)**: Specify the approximate or exact mean age, to two decimal places. If a study provided a mean age in months, convert it into **a year unit** by dividing the months into 12 (e.g., 108 months/12 = 9 years). If mean age cannot be determined, put an X mark in #2 box, $\boxed{X}$

8. **Total Sample Size**: Type the actual number of students at the starting point of research. If the number of subjects indicated in a paragraph is inconsistent with that of a demographic table, write the number of subjects in a demographic table.
9. **Sex:** Report the original information on composition of male students among all participants provided by the article. Clarify the unit first - percentages (%) or numbers (persons) - before typing. If a study didn't provide any information, put an X mark in # 3box, $\boxed{X}$
10. **Ethnicity**: Specify the ethnic composition as presented in the original information in the article.
    Choose a unit first and circle it between persons and percentages (%), and then report the original information in the article. If a study provided no information on a certain ethnic group, just write "no-info" instead of 0 (zero). If a study (e.g., Study 16) provided the number of Kurdish, combine it with the number of 'Other minority.' If there is no information, put an X in the box, $\boxed{X}$
11. **Total Number of Students with Disabilities**: Type the total number of students with disabilities who participated in a study at the starting point of research.
12. **Type of Disabilities**: Specify the composition of disability group as the original information presented in an article. Type the number of students with disabilities according to the type of disability group in the table. If a study provided other disability type than those in the table, specify it in the category of "Other" (e.g., visual impairment). If there is no information, put an X in the box, $\boxed{X}$

Treatment Descriptors

13. **Multimedia Technology**: If a study used a multimedia technology such as video or computer, select code 1. If no multimedia technology was used, select code 2.
14. **Treatment Duration**: Record the treatment duration in a study (e.g., 6 weeks). If the information was not provided, put an X in the boxes, $\boxed{X}\boxed{X}$
15. **Total Treatment Sessions**: Record the total number of times a treatment session was implemented in a study (e.g., 22 times). If the information was not provided, put an X in the boxes, $\boxed{X}\boxed{X}$

APPENDIX D

Coding Form

Coder Name	
Coding Time	about ( ) *minutes.*
Confidence Rating (1 low → 5 high)	1 2 3 4 5

Bibliographic Reference

1. ☐☐ 1. **Study ID Number** (given)
2. ☐ 2. **Type of Publication**
   1) Journal article
   2) Thesis or Dissertation
   3) Other (specify):___________________________

3. ☐☐☐☐ 3. **Publication Year** (four digits)

Sample Descriptors

4. ☐ 4. **School**
   1) Elementary
   2) Middle
   3) High
   4) Elementary & Middle
   5) Middle & High
   6) No information on school provided

5. ☐ 5. **Domain Subject**
   1) Reading
   2) Math
   3) Science
   4) Social Studies
   5) Language Arts
   6) Other (specify): __________________________

6. ☐ *and* ☐ 6. **Grade** (Report all grades, if more than two)

7. ☐☐ ☐☐ ☐ 7. **Mean Age (yrs):**
   1) Report mean age to two decimal places
   2) No information on mean age; X if unknown

8. ☐☐☐ 8. **Total Sample Size**

9. **Sex:** Choose one of the two forms (1 or 2), and then report the original informa tion in the article; (X) if unknown

9. **(** **) %** 1) Percentage of Males

, *or* **(** **)** out of **(** **)** 2) The Number of Males

☐ 3) No information on sex/gender provided

10. 10. **Ethnicity:** Choose one of the two units (persons, or %), and then report the ori ginal information in the article; if there is no information on a certain ethnic gro up, just write "no-info" instead of 0 (zero).

Caucasian/White		persons, or %
African American/Black		persons, or %
Hispanic		persons, or %
Asian		persons, or %
Other Minority		persons, or %

☐ No information on ethnicity provided

11. ☐☐ 11. **Total Number of Students with Disabilities**

12. 12. **Types of disabilities**: Check all that apply

Learning Disabilities	persons
Emotional/Behavioral Disorders	persons
Intellectual Disabilities/Mental Retardation	persons
Speech/Language Disabilities	persons
OHI/ADD, ADHD	persons
Disabilities in more than one area	persons
Other (Specify): ___________________________	persons

☐ No information on types of disabilities

<u>Treatment Descriptors</u>

13. ☐ **13.** Does the treatment use **multimedia technology**? (e.g., video or computer)

1) Yes
2) No

14. ☐☐ *weeks* **14. Treatment Duration (weeks)** in a study; X if unknown

15. ☐☐ *times* **15. Total Treatment Sessions** (# of times or sessions) in a study; X if unknown

REFERENCES

Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., & Wittrock, M.C. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives.* New York: Longman.

Anderson, J.R., Reder, L.M., & Simon, H.A. (1996). Situated learning and education, *Educational Researcher, 25*(4), 5-11.

Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of child development. Vol.6. Six theories of child development* (pp. 1-60). Greenwich, CT: JAI Press.

Bandura, A. (2000). Social cognitive theory. In D. Schunk (Ed.), *Learning theories: An educational perspective* (pp. 78-118). Boston: Merrill-Prentice Hall.

Barab, S., & Duffy, T. (2000). From practice fields to communities of practice. In D. Jonassen & S. Land (Eds.), *Theoretical foundations of learning environments* (pp. 25-55). Mahwah, NJ: Lawrence Erlbaum.

Barrows, H.S. (1996). Problem-based learning in medicine and beyond. In L. Wilkerson & W.H. Gijselaers (Eds.), *New directions for teaching and learning: Bringing problem-based learning to higher education: Theory and practice* (pp. 3-13). San Francisco: Jossey-Bass.

Bartelheim, F.J., & Evans, R. (1993). The presence of reflective-practice indicators in special education resource teachers' instructional decision making. *The Journal of Special Education, 27*(3), 338-347.

Bean, R.M., Zigmond, N., & Hartman, D.K. (1994). Adapted use of social studies textbooks in elementary classrooms: Views of classroom teachers. *Remedial and Special Education, 15,*216-226

Blackhurst, A. E. (2005). Perspectives on applications of technology in the field of learning disabilities. *Learning Disability Quarterly, 28*, 175-178.

Bottge, B.A., & Hasselbring, T.S. (1993). A comparison of two approaches for teaching complex, authentic mathematics problems to adolescents in remedial math classes. *Exceptional Children, 59*, 556-566.

Bottge, B. A., Heinrichs, M., Chan, S., & Serlin, R. C. (2001). Anchoring adolescents' understanding of math concepts in rich problem-solving environments. *Remedial and Special Education, 22*(5), 299-314.

Bottge, B. A., Heinrichs, M., Mehta, Z. D., & Hung, Y. H. (2002). Weighing the benefits of anchored math instruction for students with disabilities in general education classes. *Journal of Special Education, 35*(4), 186-200.

Bottage, B. A., Heinrichs, M., Chan, S. Y., & Mehta, Z. D. (2003). Effects of video-based and applied problems on the procedural math skills of average- and low-achieving adolescents. *Journal of Special Education Technology, 18*(2), 5-22.

Bottge, B. A., Heinrichs, M., Mehta, Z. D., Rueda, E., Hung, Y., & Danneker, J. (2004, April). Teaching mathematical problem solving to middle school students in math, technology education, and special education classrooms. *Research in Middle Level Education Online, 27*(1), 43-68.

Bottge, B.A., Rueda, E., LaRoque, R.T., Serlin, R.C., & Kwon, J. (2007). Integrating reform-oriented math instruction in special education settings. *Learning Disabilities Research & Practice, 22*(2), 96-109.

Bottge, B.A, Rueda, E., Serlin, R.C., Hung, S.Y-H, & Kwon, J.M. (2007). Shrinking achievement differences with anchored math problems: Challenges and possibilities. *The Journal of Special Education, 41*(1), 31-49.

Bransford, J., Vye, N., & Bateman, H. (1999). Creating high-quality learning environments: Guidelines from research on How People Learn. In J. Bransford (Ed.), *How people learn* (pp. 159-198). Washington DC: National Academy of Science.

Brown, J.S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher,* 32-42.

Ceci, S.J., & Roazzi, A. (1994). The effects of context on cognition: Post-cards from Brazil. In R.J. Sternberg & R.K. Wagner (Eds.), *Mind in context: Interactionist perspectives on human intelligence* (pp. 74-101). New York: Cambridge University Press.

Clark, R. (1994). Media will never influence learning. *Educational Technology Research and Development, 42*(2), 21-29.

Cohen, J. (1988). *Statistical power analyses for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Cognition and Technology Group at Vanderbilt. (1992a). The Jasper experiment: An exploration of issues in learning and instructional design. *Educational Technology Research and Development, 40*(1), 65-80

Cognition and Technology Group at Vanderbilt. (1992b). The Jasper series as an example of anchored instruction: Theory, program description, and assessment data. *Educational Psychologist, 27*(3), 291-315.

Cooper, H., & Hedges, L.V. (Eds.) (1994). *The handbook of research synthesis*. New York: Russell Sage Foundation.

Cooper, G., & Sweller, J. (1987). Effects of schema acquisition and rule automation on mathematical problem solving transfer. *Journal of Educational Psychology,* 79, 347-362.

Cosden, M., & Abernathy, T. (1990). Microcomputer use in the schools: Teacher roles and instructional options. *Remedial and Special Education, 11*(5), 31-38.

Curtis, C.K. (1991). Social studies for students at-risk and with disabilities. In J.P. Shaver (Ed.), *Handbook of research on social studies teaching and learning* (pp. 157-174). New York: Macmillan.

De La Paz, S., & MacArthur, C. (2003). Knowing the how and why of history: Expectations for secondary students with and without disabilities. *Learning Disability Quarterly, 26,* 142-154.

Denton, C. A., Vaughn, S., & Fletcher, J. M. (2003). Bringing research-based practice in reading intervention to scale. *Learning Disabilities Research & Practice, 18*(3), 201-211.

Dewey, J. (1929). *The quest for certainty*. New York: G. P. Putnam.

Dimino, J.A., Taylor, R.M., & Gersten, R.M. (1995) Synthesis of the research on story grammar as a means to increase comprehension, Reading & Writing Quarterly, 11(1), 53-72.

Dorn, S., & Fuchs, D. (2004). Trends in placement issues. In A.M. Sorrells, H.J. Rieth, & P.T. Sindelar (Eds.), *Critical issues in special education: Access, diversity, and accountability* (pp. 57-72). Boston, MA: Pearson Education, Inc.

Druckman, D., & Bjork, R.A. (1992). Optimizing long-term retention and transfer. In D. Druckman & R.A. Bjork (Eds.), *The mind's eye: enhancing human performance* (pp. 23-56). Washington, DC: National Academies Press.

Ertmer, P.A. (2005). Teacher pedagogical beliefs: The final frontier in our quest for technology integration? *Educational Technology Research & Development, 53*(4), 25-39.

Feldman, K., & Denti, L. (2004). High-access instruction: Practical strategies to increase active learning in diverse classrooms. *Focus on Exceptional Children. 36*(7), 1-12.

Ferretti, R.P., MacArthur, C.D., & Okolo, C.M. (2001). Teaching for historical understanding in inclusive classrooms. *Learning Disability Quarterly, 24*, 50-71.

Ferretti, R.P. & Okolo, C.M. (1996). Authenticity in learning: Multimedia design projects in the social studies for students with disabilities, *Journal of Learning Disabilities, 29*(5), 450-460.

Fuchs, L.S., & Fuchs, D. (2003). Enhancing the mathematical problem solving of students with mathematics disabilities. In H.L. Swanson, K.R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities.* (pp. 383-402). New York, US: Guilford Press.

Gersten, R. (1998). Recent advances in instructional research for students with learning disabilities: An overview. *Learning Disabilities Research & Practice, 13*(3), 162-170.

Gersten R., Baker, S.K., Smith-Johnson, S., Dimino, J., & Peterson, A. (2006). Eyes on the prize: Teaching complex historical content to middle school students with learning disabilities, *Exceptional Children, 72*(3), 264-280.

Gersten, R., Fuchs, L.S., Coyne, M., Greenwood, C., & Innocenti, M.S. (2005). Quality indicators for group experimental and quasi-experimental research in special education, Exceptional Children, 71(2), 149-164.

Gijbels, D., Dochy, F., Bossche, P.V., & Segers, M. (2005). Effects of problem-based learning: A meta-analysis from the angle of assessment. *Review of Educational Research, 75*(1), 27-61.

Glaser, C. W., Rieth, H. J., Kinzer, C. K., Colburn, L. K., & Peter, J. (1999). A description of the impact of multimedia anchored instruction on classroom interactions. *Journal of Special Education Technology, 14*(2), 27-43

Glass, G.V. (1976). Primary, secondary, and meta-analysis. *Educational Researcher*, *5*, pp. 3-8.

Goldman, S.R, Hasselbring, T.S., & Cognition and Technology Group at Vanderbilt (1997). Achieving meaningful mathematics literacy for students with learning disabilities, *Journal of Learning Disabilities, 30*(2), 198-208.

Greeno, J., Collins, A., & Resnick, L. (1996). Cognition and learning. In D. Berliner & R. Calfee (Eds.), *Handbook of educational psychology* (pp. 15-46). New York:

Simon-Schuster MacMillan.

Gropper, G. (1983). A behavioral approach to instructional prescription. In J. Reigeluth (Ed.), *Instructional-design theories and models: An overview of their current status* (pp. 101-161). Mahwah, NJ: Lawrence Erlbaum Publishers.

Hall, T.E., Hughes, C.A., & Filbert, M. (2000). Computer assisted instruction in reading for students with learning disabilities: A research synthesis. *Education and Treatment of Children, 23*(2), 173-193.

Hall, J.A., Tickle-Degnen, L., Rosenthal, R., & Mosteller, F. (1994). Hypotheses and problems in research synthesis. In H. Cooper & L.V. Hedges (Eds.). *The handbook of research synthesis* (pp. 17-27). New York: Russell Sage Foundation.

Haskell, R. (2001). *Transfer of learning: Cognition, instruction and reasoning*. San Diego: Academic Press.

Hasselbring, T.S. & Moore, P.R. (1996). Developing mathematical literacy through the use of contextualized learning environments. *Journal of Computing in Childhood Education, 7*(3-4), 199-222.

Hedges, L.V. & Olkin, I. (1985). *Statistical models for meta-analysis*. New York: Academic Press.

Heo, Y.S. (2007). The impact of multimedia anchored instruction on the motivation to learn of students with and without learning disabilities placed in inclusive middle school language arts classes. *Dissertation Abstracts International, 68(12)*. (UMI No. 3290930)

Herrington, J., & Oliver, R. (1995). Critical characteristics of situated learning:

Implications for the instructional design of multimedia. Retrieved March 09, 2006, from http://www.ascilite.org.au/conferences.melbourne95/smut_bak/papers/herrington.pdf

Hershberger, S. L., Wallace, D. D., Green, S. B., & Marquis, J. G. (1999). Meta-analysis of single-case designs. In R.H. Hoyle (Ed.) *Statistical strategies for small sample research.* Thousand Oaks, CA: Sage Publications.

Hunter & Schmidt (2000). Fixed effects vs. random effects meta-analysis models: Implications for cumulative research knowledge. Implications for Cumulative Research Knowledge, 8(4), 275-292.

Hur, S.J. (2001). Effects of anchored instruction on the critical-thinking skills of students with and without mild disabilities. *Dissertation Abstracts International, 62*(12). (UMI No. 3037504)

Individuals with Disabilities Education Act, PL. 105-17, 111 Stat. 37 (1997).

Individuals with Disabilities Education Improvement Act of 2004, Pub. L. No. 108-, 446 (2004).

Kim, A., Vaughn, S., Wanzek, J., & Wei, S. (2004). Graphic organizers and their effects on the reading comprehension of students with LD: A synthesis of research. *Journal of Learning Disabilities, 37*(2), 105-118.

Knight, J. (2002). Crossing boundaries: What constructivists can teach intensive-explicit instructors and vice versa. *Focus Exceptional Children, 35*(4), 1-15.

Lave, J. (1991). Situated learning in communities of practice. In L.B. Resnick, J.M. Levine, & S.D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 63-

82). Washington, DC: American Psychological Association.

Lewis, R.B. (2000). Musings on Technology and Learning Disabilities on the Occasion of the New Millennium. *Journal of Special Education Technology, 15*(2), 5-12.

Linen-Thompson, S. (2004). Instructional interventions for students with learning disabilities. In A. M. Sorrells, H. J. Rieth, & P. T. Sindelar (Eds.), *Critical issues in special education: Access, diversity, and accountability* (pp.125-134). Boston, US: Pearson Education, Inc.

Lipsey, M.W. (1994). Identifying potentially interesting variables and analysis opportunities. In H. Cooper & L.V. Hedge (Eds.), *The handbook of research synthesis* (pp. 111-123). New York: Russell Sage Foundation.

Lipsey, M. W., & Wilson, D. B. (2001). *Practical Meta-Analysis.* Thousand Oaks, CA: Sage Publication.

Lock, R.H., & Carlson, D.M. (2000). Planning for effective, enjoyable computer lab use. *Teaching Exceptional Children, 32,* 4-7.

Love, M. S. (2004). Multimodality of learning through anchored instruction. *Journal of Adolescent and Adult Literacy, 48*(4), 300-310.

Maccini, P., Gagnon, J.C., & Hughes, C.A. (2002). Technology-based practices for secondary students with learning disabilities. *Learning Disability Quarterly, 25*, 247-261.

Margolis, H., & McCabe, P. (2004). Self-Efficacy: A Key to Improving the Motivation of Struggling Learners. *Clearing House, 77*(6), pp. 241-249.

Mayer, R.E. (2002). A taxonomy for computer-based assessment of problem solving.

Computers in Human Behavior, 18, 623-632.

Mayer, R.E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychology, 38*(1), 43-52.

McCray, A.D., Vaughn, S., & Neal, L.V.I. (2001). Not all students learn to read by third grade: Middle school students speak out about their reading disabilities. *The Journal of Special Education, 35*(1), 17-30.

McLarty, K., Goodman, J., Risko, V., Kinzer, C. K., Vye, N., Rowe, D., & Carson, J. (1990). Implementing anchored instruction: Guiding principles for curriculum development. In J. Zutell & S. McCormick (Eds.), *Literacy theory and research: Analyses from multiple paradigms* (pp. 109-120). Chicago: National Reading Conference.

McLellan, H. (1991). Virtual environments and situated learning. *Multimedia Review, 2* (3), pp. 30-37.

Miller, S. P. & Hudson, P.L (2007). Using evidence-based practices to build mathematics competence related to conceptual, procedural, and declarative knowledge. *Learning Disabilities Practices, 22*(1), 47-57.

Morris, S.B., & DeShon, R.P. (2002). Combining effect size estimates in meta-analysis with repeated measures and independent-group designs. *Psychological Methods, 7*(1), 105-125.

Morrissey, P.A., & Semmel, M.I. (2001). Instructional models for the learning disabled. *Theory Into Practice, 14*(2), 110-122.

Muir-Herzig, R.G. (2004). Technology and its impact in the classroom. *Computers and*

Education, 42, 111-131.

NAEP (2006). The nation's report card: U.S. History report card in 2006. Washington, DC: National Center for Educational Statistics. Retrieved October, 26, from http://nationsreportcard.gov/ushistory_2006/h0109.asp?tab_id=tab2&subtab_id=Tab_2#chart

NAEP (2009). The nation's report card: Mathematics report card in 2009. Washington, DC: National Center for Educational Statistics. Retrieved October, 26, from http://nces.ed.gov/nationsreportcard/pdf/main2009/2010451.pdf

National Council of Teachers of Mathematics (2000). Principles and standards for school mathematics. Retrieved October, 25, 2010, from http://standards.nctm.org/document/appendix/process.htm

National Center for Education Statistics (NCES). (2003). Public schools and school classrooms with access to the Internet, by selected school characteristics: 1994 to 2001. Retrieved March, 10, 2008, from http://nces.ed.gov//pubs2003/digest02/tables/dt419.asp

Neil,M., Guisbond, L., Schaeffer, B, Madden, J., & Legeros, L. (2004). *Failing our children: How "no child left behind" undermines quality and equity in education. An accountability model that supports school improvement.* Cambridge, MA: FairTest: The National Center for Fair and Open Testing. Retrieved October 20, 2010, from http://epsl.asu.edu/epru/articles/EPRU-0405-62-OWI.pdf

No Child Left Behind Act of 2001, Pub. L. No. 107-110. (2002).

Okolo, C.M., Cavalier, A.R., Ferretti, R.P., & MacArthur, C.A. (2000). Technology, literacy, and disabilities: A review of the research. In R. Gersten, E.P., Schiller, S.Vaughn (Eds.), *Contemporary special education research: Syntheses of the knowledge based on critical instructional issues* (pp. 179-250). Mahwah, NJ:Erlbaum.

Orwin, R.G. (1994). Evaluating coding decisions. In H. Cooper & L.V. Hedges (Eds.), *The handbook of research synthesis* (pp. 139-162). New York: Russell Sage Foundation.

Palincsar, A.S. (1998). Social constructivist perspectives on teaching and learning, *Annual Review of Psychology, 49*, 345-375.

Paulsen, K.J. (2005). Infusing evidence-based practices into the special education preparation curriculum. *Teacher Education and Special Education, 28*(1), 21-28.

Pellegrino, J. W., Heath, A., Warren, S., & The Cognition and Technology Group at Vanderbilt. (1991). *Collaboration at a distance: A Jasper implementation experiment in nine states.* Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.

Pierson, M. E. (2001). Technology integration practice as a function of pedagogical expertise. *Journal of Research on Computing in Education, 33*(4), 413-430.

Reigeluth, C.M. (1999). The elaboration theory: Guidance for scope and sequence decisions. In C.M. Reigeluth (Ed.), *Instructional-design theories and models.* (pp. 425-453) Mahwah, NJ: Lawrence Erlbaum.

Rieth, H. J., Bryant, D. P., Kinzer, C. K., Colburn, L. K., Hur, S., Hartman, P., & Choi, H. (2003). An analysis of the impact of anchored instruction on teaching and learning activities in two ninth-grade language arts classes. *Remedial and Special Education, 24*(3), 173-184.

Rieth, H.J., & Colburn, L. (2003). Anchoring instruction for students with disabilities. In D.P. Bryant, & B.R. Bryant (Eds.), *Assistive technology for people with disabilities* (pp. 174-193). Boston: Person Education, Inc.

Rieth, H. J., Colburn, L. K., & Bryant, D. P. (2004). Trends and issues in instructional and assistive technology. In A.M. Sorrells, H.J. Rieth, & P. T. Sindelar (Eds.), *Critical issues in special education: Access, diversity, and accountability.* (pp.205-225). Boston, US: Pearson Education, Inc.

Roschelle, J.M., Pea, R.D., Hoadley, M.C., Gordin, D.N., & Means, B.M. (2000). Changing how and what children learn in school with computer-based technologies. *The Future of Children, 10*(2), 76-101.

Rosenshine, B. (1987). Explicit teaching and teacher training. *Journal of Teacher Education, 38* (3). 34-36.

Rosenthal, D.A., Hoyt, W.T., Ferrin, J,M., Miller, S., & Cohen, N.D. (2006). Advanced methods in meta-analytic research: Applications and implications for rehabilitation counseling research, *Rehabilitation Counseling Bulletin, 49*(4), pp. 234-246.

Raudenbush, S.W. (1994). Random effects models. In H. Cooper & L.V. Hedges (Eds.), *The handbook of research synthesis* (pp. 301-322). New York: Russell Sage Foundation.

Schulze, R. (2007). Current methods for meta-analysis: Approach, issues, and developments. *Journal of Psychology, 215*(2), 90-103.

Schunk, D.H. (1999). Social cognitive theory. In D.H. Schunk, *Learning theories: An educational perspective* (pp. 78-118). New York: Prentice Hall.

Scruggs, T.E. & Mastropieri, M.A. (2003). Science and social studies, In H.L.Swanson, K.R. Harris, & S. Graham (Eds.), *Handbook of learning disabilities* (pp. 364-379). New York, US: Guilford Press.

Scruggs, T.E. & Mastropieri, M.A. (2007). Science learning in special education: The case for constructed versus instructed learning, *Exceptionality, 15*(2), 57-74.

Stipek, D. (1996). Motivation and Instruction. In D. Berliner, & R. Calfee (Eds.), *Handbook of educational psychology* (pp. 85-113). New York: NY: Simon Schuster MacMillan.

Stock, W. A. (1994). Systematic coding for research synthesis. In H. Cooper & L.V. Hedges (Eds.), *The handbook of research synthesis* (pp. 125-138). New York: Russell Sage Foundation.

Stockall, N., & Gartin, B. (2002). The nature of inclusion in a blue ribbon school: A revelatory case. *Exceptionality, 10*(3), 171-188.

Stough, L.M., & Palmer, D. (2003). Special thinking in special settings: A qualitative study of expert special educators. *Journal of Special Education, 36*(4), 204-222.

Sugrue, B. (1993). Specifications for the design of problem-solving assessments in science: Project 2.1. Designs for assessing individual and group problem-solving. National center for research on evaluation, standards, student testing. Los Angeles CA. (ERIC Document Reproduction Service No. ED371082)

Sugrue, B. (1995). A theory-based framework for assessing domain-specific problem solving ability. *Educational Measurement: Issues and Practice, 14*(3), 29-36.

Swanson, L. (2001). Searching for the best model for instructing students with learning disabilities, *Focus on Exceptional Children, 34*(2), 1-14.

Thompson,S.J., Lazarus,S.S., Clapper,A.T., & Thurlow,M.L. (2006). Adequate yearly progress for students with disabilities: Competencies for teachers. *Teacher Education and Special Education, 29*(2), 137-147.

Turnbull, H.R. (2009). Today's policy contexts for special education and students with specific learning disabilities, *Learning Disability Quarterly, 32*(1) p3-9.

U.S. Census Bereau (2008). The 2008 statistical abstract: The national data book. Retrieved September, 26, 2008. from http://blueprod.ssd.census.gov/prod/2007pubs/08abstract/educ.pdf

Vaughn, S., Gersten, R., & Chard, D. (2000). The underlying message in LD intervention research: Findings from research syntheses. *Exceptional Children, 67*(1), 99-114.

Vaughn, S., Klinger, J.K., & Bryant, D. (2001). Collaborative strategic reading as a means to enhance peer-mediated instruction for reading comprehension and content-area learning. *Remedial and Special Education, 22*(2), 66-74.

Vaughn, S., & Schumm, J.S. (1995). Responsible inclusion for students with learning disabilities. *Journal of Learning Disabilities, 28*(5), 264-270.

Whitehead, A.M. (1929). *The aims of education*. New York: MacMillan.

Wilder A.A., & Williams, J.P. (2001). Students with severe learning disabilities can learn higher order comprehension skills, *Journal of Educational Psychology, 93*(2), 268-278.

Wilson, B.B., & Myers, K. M. (2000). Situated Cognition in Theoretical and Practical Context. In D. Jonassen, & S. Land (Eds.) *Theoretical foundations of learning environments* (pp. 57-88). Mahway, NJ: Lawrence Erlbaum Associates.

Wineburg, S.S. (1996). The psychology of learning and teaching history. In D.C. Berliner & R. Calfee (Eds.), *The handbook of educational psychology* (pp. 423-437). New York: Macmillan.

Wong, B.Y.L., Harris, K.R., Graham, S. Butler, D. (2003). Cognitive strategies instruction research in learning disabilities. In H.L. Swanson, K.R. Harris, S. Graham (Eds.), *Handbook of learning disabilities* (pp. 383-402). New York, US: Guilford Press.

Woodward, J., & Rieth, H. (1997). A historical review of technology research in special education. *Technology in Special Education, 67*(4), 503-536.

Woodward, J. (2004). Mathematics education in the United States: Past to present, *Journal of Learning Disabilities, 37,* 16-31.

Xin, F., Glaser, C. W., Rieth, H. (1996). Multimedia reading using anchored instruction and video technology in vocabulary lessons. *Teaching Exceptional Children, 29*(2), 45-49.

Young, M. F. (1993). Instructional design for situated learning. *Educational Technology Research and Development, 41*(1), 43-58.

VITA

Jiyoung Kim received her Bachelor's degree in Special Education from Ewha University in 1994. She served as a special education teacher at Holt Children's Services Institutions and Holt School for Mental Retardation from the summer of 1994 to 1998. She was the lead teacher of a newly opened kindergarten class in the Holt School for children with disabilities. There she developed a new kindergarten curriculum for students with special needs, set up instructional materials and evaluation criteria, and delivered early childhood education to her students with diverse disabilities. In 2000, Jiyoung Kim entered graduate school at Seoul National University and earned her Master's degree in Educational Technology in 2003. In the fall of 2005, she entered the doctoral program at The University of Texas at Austin to pursue a doctorate in Special Education.

E-mail Address: jykim412@gmail.com

This dissertation was typed by the author.